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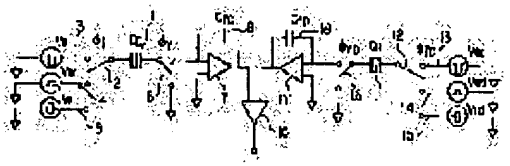
(54) NONDESTRUCTIVE FERROELECTRIC MEMORY AND DRIVING METHOD THEREFOR

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain a nondestructive ferroelectric memory suitable for high integration in which nondestructive read-out can be realized without causing any interference with nonselected memory cell at the time of reading or writing data by employing a feedback circuit added with a capacitor, a sense circuit, etc.
SOLUTION: Information in a memory cell 1 is erased by a first pulse having voltage Ve higher than a coercive voltage Vc. Information is written in by a second pulse having voltage Vw, the absolute value thereof is lower than the voltage Ve of reverse polarity. A feedback circuit system added with a capacitor for reading out a small $\Delta C/C$ without requiring any voltage variation on the data line and a sense circuit combining comparative read-out with a reference dummy cell 11 comprising a ferroelectric are additionally provided.



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CLAIMS

[Claim(s)]
[Claim 1] Ferroelectric random-access memory using the storage cell which memorizes information according to the state of spontaneous polarization (polarization) of the ferroelectric thin film pinched by one pair of electrodes characterized by providing the following. The 1st terminal for impressing the 1st pulse for elimination of the storage information which has the larger voltage Ve than the anti-voltage Vc of the aforementioned ferroelectric thin film to the aforementioned storage cell. The 2nd terminal for impressing the 2nd pulse for information writing which has the voltage Vw which has an absolute value with the aforementioned applied voltage Ve smaller than Ve of reversed polarity in the aforementioned storage cell. The 3rd terminal for impressing the 3rd pulse for having one of the positive or negative voltage Vr with the following absolute values in the aforementioned storage cell, and reading memory information to it in un-destroying from the aforementioned voltage Ve. The 1st selecting-switch means which chooses either the above 1st or the 3rd terminal, The 1st differential type amplifier which has the capacity for feedback connected to the output side of the aforementioned storage cell through 1st circuit-changing-switch means by which an end is grounded, and was able to apply feedback to the output, Consist of a ferroelectric thin film equivalent to the aforementioned storage cell, and the same information as the information memorized by this storage cell is memorized. The 4th or 6th terminal with which the above 1st linked to the dummy cell for reference which performs comparison read-out arbitrarily, or a pulse signal equivalent to the 3rd pulse signal is impressed, The 2nd selecting-switch means which chooses either the above 4th or the 6th terminal, and is impressed to this dummy cell for reference, The 2nd differential type amplifier which has the capacity for feedback connected to the output side of the aforementioned dummy cell for reference through 2nd circuit-changing-switch means by which an end is grounded, and was able to apply feedback to the output, The differential type amplifier of the 3rd ** which outputs the difference of the differential type amplifier of the above 1st and the differential type amplifier of the above 2nd is provided. by the above 1st, the 2nd selecting-switch means and the 1st, and 2nd circuit-changing-switch means Elimination, writing, and read-out of the information on the aforementioned storage cell and the aforementioned dummy cell for reference are performed. The aforementioned storage cell and the aforementioned dummy cell for reference impress and polarize the 1st pulse of the aforementioned voltage Ve in the 1st polarization state of the two states of the spontaneous polarization of the aforementioned account dielectric thin film of strength, and, next, it is the aforementioned voltage Vw.
[Claim 2] It has two or more storage cells and at least one dummy cell for reference which memorize information according to the state of spontaneous polarization (polarization) of the ferroelectric thin film pinched by one pair of electrodes. The 1st pulse which has the larger voltage Ve than the anti-voltage Vc of the aforementioned ferroelectric thin film is impressed and polarized in the 1st polarization state of the two states of spontaneous polarization (polarization) of the aforementioned ferroelectric thin film. Next, the domain which impresses the 2nd pulse which has the voltage Vw with an absolute value with the aforementioned applied voltage Ve smaller than Ve of reversed polarity, and has polarization of the 1st direction of the above. The 1st direction of the above is the 2nd polarization of an opposite direction. It is the un-destroying type ferroelectric memory equipped with the above. the aforementioned storage cell and the aforementioned dummy cell for reference The memory cell mat which was inserted into the stripe electrode of the couple which intersects perpendicularly mutually on a semiconductor chip, and has been arranged at the simple matrix is formed. the aforementioned memory cell mat It is characterized by being classified into one or more sectors which consist of aforementioned storage cells of an arbitrary number, putting at least one or more aforementioned dummy cells for reference on this sector, and eliminating the information on the storage cell in this memory cell mat in package on a semiconductor chip.
[Claim 3] It has the storage cell which memorizes information according to the state of spontaneous polarization (polarization) of the ferroelectric thin film pinched by one pair of electrodes. The 1st pulse which has the larger voltage

Ve than the anti-voltage Vc of the aforementioned ferroelectric thin film is impressed and polarized in the 1st polarization state of the two states of spontaneous polarization (polarization) of the aforementioned ferroelectric thin film. Next, the domain which impresses the 2nd pulse which has the voltage Vw with an absolute value with the aforementioned applied voltage Ve smaller than Ve of reversed polarity, and has polarization of the 1st direction of the above. The 1st direction of the above is the 2nd polarization of an opposite direction. It is the un-destroying type ferroelectric memory equipped with the above, and the aforementioned ferroelectric random-access memory is characterized by being the memory apparatus which consists of the memory section which is formed on one a semiconductor chip or two or more semiconductor chips, and which has a storage cell, an antenna, a tuning circuit, a detector circuit, a demodulator circuit, an oscillator circuit, a modulation circuit, and a control circuit, and performs informational communication and informational processing using an electric wave and in which desorption is possible.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the un-destroying type ferroelectric memory which started the solid-state type recording device used for an electronic circuitry, especially used the ferroelectric thin film.
[0002]
[Description of the Prior Art] Generally, the high-density and highly efficient memory apparatus is demanded with development of a computer and picture equipment. As a conventional memory apparatus, external memory equipments, such as a magnetic tape, a floppy disk, and a magneto-optic disk, or semiconductor memory, i.e., DRAM, SRAM, EPROM, and EEPROM, the flash memory, etc. were used.
[0003] And when multimedia and a computer are united, as a memory apparatus, more highly efficient and compact memory [say / that it is a high-speed low-battery drive, and is the solid-state memory of drive loess the 3rd] is needed / 1st / for a non-volatile and the 2nd. However, it may be unable to correspond with the technology of the conventional recording device.
[0004] As a memory apparatus which responds to this, there is ferroelectric memory which is indicated by USP4,873,664 (S. Sheffield Eaton Jr., Colorado Springs, CO).
[0005] The composition of this ferroelectric random-access memory is shown in drawing 31 .
[0006] The ferroelectric thin film capacity 302 in a memory cell 301 is a switching element, and has the composition of having changed into ferroelectric capacity the storage capacitance of the DRAM method driven by FET303. The drive to a memory cell is connected to the WORD line 304, the plate line 305, and the bit line 308, and a sense amplifier 307 performs the read-out.
[0007] It is inconvenient, when a degree of integration and cost become of the same grade as DRAM and FLASH memory of semiconductor memory, for example, it makes several 100 M bytes of card from this composition, since the sense amplifier 307 is formed on Si device.
[0008] On the other hand, the method currently indicated by USP5,060,191 is a method which makes simple matrix structure from the ferroelectric material 313, and carries out a signal detection in the read-out drive circuit 314,315, as shown in drawing 32 .
[0009] A cell adjoins, and is arranged and the problem that the memory which consisted of such simple matrices is big is interference with the selected cell and a non-choosing cell. For example, when choosing a certain cell, performing writing/read-out and voltage Va is impressed, voltage will be impressed also to the non-choosing cell which is not chosen. Va/2 will be impressed to the non-choosing cell connected to the electrode line of the input side/output side of a selection cell as the number of cells becomes large especially.
[0010] Then, in the above USP5,060,191, as opposed to the applied voltage Va to a selection cell, it devises so that Va/3 may be impressed by the non-choosing cell, and write-in operation is performed. Moreover, read-out read the voltage of a low impedance and has cut the noise from a non-choosing cell. However, if the required voltage Va is impressed to polarization reversal of a selection cell at the time of writing, the polarization state of a non-choosing cell will be destroyed by many impression even on the voltage of Va/3.
[0011] moreover, in USP5,140,548 (C. J.Brennan) In the state of 320 which both the space charge layer and the neutral region existed in the ferroelectric, considered that made the capacity-voltage characteristic like drawing 33 , and was written in on negative voltage, and the state of 321 written in on positive voltage If capacity is measured with AC signal which superimposed the voltage Vb below a certain anti-voltage Vth impression and on this, in the "1" state, binary [of the capacity of 323] will be obtained in the capacity of 322, and "0" states, and "1" and "0" will be distinguished with this difference. Therefore, it carries out [that it can read by impressing the read-out voltage of Vb

with a time constant longer than the relaxation time of space charge, and impressing the alternating current wave which has a frequency component quicker than the relaxation time, without changing a polarization state, and], after writing in.

[0012]

[Problem(s) to be Solved by the Invention] However, as a trouble of the conventional technology mentioned above, although the implementability is comparatively easy for the combination with a semiconductor in the composition shown in drawing 31 , neither a degree of integration nor cost changes with DRAM by using Si device, i.e., a switching element and FET.

[0013] Moreover, the ferroelectric random-access memory of the simple matrix composition shown in drawing 32 is not indicating the guarantee to polarization destruction of a ferroelectric cell concretely at the time of writing.

[0014] The method of using capacity change shown in drawing 33 has the problem generated to the equipment shown in drawing 32 as it is at the time of writing, when it applies to a simple matrix. About voltage Vb, it will read, if it is going to read with sufficient S/N at the time of read-out, and a certain amount of size must be impressed, and by many impression, change of polarization takes place too and it does not become destructive read.

[0015] Then, this invention aims at offering the un-destroying type ferroelectric memory which has the incoherency to the storage cell of not choosing at the time of informational writing and read-out, and can realize nondestructive read, and carries out suitable to large-scale-ization.

[0016]

[Means for Solving the Problem] In the ferroelectric random-access memory using the storage cell which memorizes information according to the state of spontaneous polarization (polarization) of the ferroelectric thin film pinched by one pair of electrodes in order that this invention may attain the above-mentioned purpose The 1st terminal for impressing the 1st pulse for elimination of the storage information which has the larger voltage Ve than the anti-voltage Vc of the aforementioned ferroelectric thin film to the aforementioned storage cell, The 2nd terminal for impressing the 2nd pulse for information writing which has the voltage Vw which has an absolute value with the aforementioned applied voltage Ve smaller than Ve of reversed polarity in the aforementioned storage cell, To the aforementioned storage cell, in the equivalent in an absolute value from the aforementioned voltage Ve Or the 3rd terminal for impressing the 3rd pulse for reading memory information in un-destroying which is one of the small positive or negative voltage Vr, The 1st selecting-switch means which chooses either the above 1st or the 3rd terminal, The 1st differential type amplifier which has the capacity for feedback connected to the output side of the aforementioned storage cell through 1st circuit-changing-switch means by which an end is grounded, and was able to apply feedback to the output, Consist of a ferroelectric thin film equivalent to the aforementioned storage cell, and the same information as the information memorized by this storage cell is memorized. The 4th or 6th terminal with which the above 1st linked to the dummy cell for reference which performs comparison read-out arbitrarily, or a pulse signal equivalent to the 3rd pulse signal is impressed, The 2nd selecting-switch means which chooses either the above 4th or the 6th terminal, and is impressed to this dummy cell for reference, The 2nd differential type amplifier which has the capacity for feedback connected to the output side of the aforementioned dummy cell for reference through 2nd circuit-changing-switch means by which an end is grounded, and was able to apply feedback to the output, It has the differential type amplifier of the 3rd ** which outputs the difference of the differential type amplifier of the above 1st, and the differential type amplifier of the above 2nd. by the above 1st, the 2nd selecting-switch means and the 1st, and 2nd circuit-changing-switch means Elimination, writing, and read-out of the information on the aforementioned storage cell and the aforementioned dummy cell for reference are performed. The un-destroying type ferroelectric memory from which the aforementioned storage cell and the aforementioned dummy cell for reference memorize information in the state of partial polarization, impress the 3rd pulse of the aforementioned voltage Vr, and read memory information in un-destroying is offered.

[0017] The above un-destroying type ferroelectric memory of composition The 1st pulse which has the larger voltage Ve than the anti-voltage Vth of the aforementioned ferroelectric thin film is impressed and polarized in the 1st polarization state of the two states of spontaneous polarization (polarization). Next, in the aforementioned applied voltage Ve, the 2nd pulse which has the voltage Vw of reversed polarity is impressed, and the domain which has polarization of the 1st direction of the above, and the 1st direction of the above memorize information in the state of partial polarization which the domain which has the 2nd polarization of an opposite direction mixed. Although it appears as a difference of capacity, since capacity-factor deltaC/C is small when reading on read-out voltage, it is necessary to amplify this state. If C considers temperature dependence, data-hold time dependency, etc. at this time, comparison read-out by the reference cell using ferroelectric capacity is required. Here, the bulk memory of this not destroying becomes possible in the sense circuit which combined comparison read-out by the capacity addition feedback circuit and reference cell which can read small deltaC/C without voltage change of the data line.

[0018]
[Embodiments of the Invention] Hereafter, with reference to a drawing, the operation form of this invention is explained in detail.
[0019] First, with reference to drawing 1 or drawing 4 , the un-destroying type ferroelectric memory apparatus by this invention and its drive method are explained.
[0020] First, as shown in drawing 2 (a), the end of the ferroelectric memory cell 1 pinched by electrodes, such as platinum, in the ferroelectric thin film is connected to the pulse input terminal 3 for elimination, the pulse input terminal 4 for writing, and the pulse input terminal 5 for read-out through a selecting switch 2. Moreover, it connects with the circuit changing switch 6 for electric discharge by which an end is grounded by the reference potential, and the input terminal of the differential amplifier 7, and it connects and the other end of the ferroelectric memory cell 1 is so that an output may be fed back for the feedback capacitative element (capacitor) 8 to the differential amplifier 7.
[0021] Thus, in the constituted ferroelectric memory apparatus, the data writing and data read-out by the signal drawing 2 (b) Shown are explained.
[0022] The data writing of this ferroelectric memory apparatus and the principle of data read-out are the same as that of Japanese Patent Application No. No. 22545 [six to] and Japanese Patent Application No. No. 9992 [seven to] which these people proposed fundamentally.
[0023] It sets in this composition and is the pulse Ve for elimination first. By inputting, the data currently recorded are eliminated and polarization by which a polarization setup was carried out in the 1st (facing down) direction is changed into "0" states to the memory cell 1. Then, pulse Vw for writing Predetermined data are written in.
[0024] Here, it is the pulse Vw for writing. Potential is the pulse Ve for elimination. It needs to be smaller than an absolute value from potential. Have both for the 1st (facing down) polarization state and the polarization state reversed in the 2nd (facing up) direction, namely, the written-in cell is a partial polarization field. That is, partial polarization is in the polarization state of having the mixed state of polarization of the 1st direction, and polarization of the 2nd direction. This state is set to "1" and shown in drawing 2 (c). Maintenance of memory is recorded in the "0" "1" state with a state, and does not have this information what deteriorates simply in temperature or prolonged maintenance. Moreover, there is a difference of a zero-bias state in "1" and "0", and it is Cs0 about Cs1 and "0" states in "1" state. If it carries out, it will be Cs0>Cs1 and will check that its difference (Cs0-Cs1) / Cs0 is about 20%.
[0025] And pulse Vr for read-out shown in drawing 2 (b) Data read-out is performed. This pulse Vr for read-out It is carried out in un-destroying and read-out to depend is the pulse Ve for elimination. It is smaller than potential in an absolute value, and is the pulse Vw for writing preferably. A small thing is desirable. In addition, pulse Vr for read-out Whichever is sufficient as polarity.
[0026] This read-out pulse Vr By impression, it is checking that about 1x1010 to 1x1012 read-out is possible in un-destroying. Moreover, the memory composition of the simple matrix structure where the field across which sandwiched the ferroelectric film by the upper electrode arranged in parallel, and an upper electrode and the lower electrode arranged in parallel with the business which goes direct mostly, and it faced by the lower electrode the top by the writing by these pulses and the method of reading becomes one memory cell is possible. And the voltage impression to a non-choosing cell is slight at the time of data writing, and it is also checking that the data recorded are not destroyed.
[0027] Therefore, according to the writing mentioned above and the method of reading, realization of the non-volatile memory which can be integrated most highly is suggested.
[0028] Here, if ferroelectric material has spontaneous polarization, it is good anything. Pb(Zr, Ti) O3 which has a perovskite structure, O(Zr (Pb, La), Ti) 3, PbTiO3, and BaTiO3 etc. -- it is general Moreover, you may be a stratified compound. For example, they are SrBi2 Ta 2O9, SrBi2 Nb 2O9, SrBi4 Ti 4O12, SrBi2 2 (Ta, Nb) O9, and Bi4 Ti3 O12 grade. Moreover, the membrane formation method is also possible also for sol gel, an organic-metal method, the sputtering method, and the MOCVD method. Moreover, according to actual driver voltage, the scaling of thickness becomes possible.
[0029] The circuitry of the un-destroying type ferroelectric memory apparatus as the 1st operation form is shown in drawing 1 , and it explains to it. Although this composition is notional, the memory apparatus of composition of having been shown in drawing 2 is symmetrically arranged by the couple focusing on the differential amplifier 10, and the end of a dummy cell 11 which consists of a ferroelectric memory cell is connected to the pulse input terminal 13 for elimination, the pulse input terminal 14 for writing, and the pulse input terminal 15 for read-out through a selecting switch 12. Moreover, the other end of a dummy cell 11 is connected to the input terminal of the switch 16 for electric discharge with which an end is grounded by the reference potential, and the differential amplifier 17, and the feedback capacitative element 18 is connected to the differential amplifier 17 so that an output may be fed back. Moreover, among drawing, the reference potential (grounding) shown by the arrow needs to be a predetermined reference

potential, and does not need to be zero potential.
[0030] With reference to drawing 3 , operation of the ferroelectric memory apparatus shown in drawing 1 is explained in detail.
[0031] Drawing 3 (a) is the ferroelectric memory apparatus of a simple matrix by which two or more memory cells 1 have been arranged, and the 1st line 19 and 2nd line 20 were connected to the shape of a matrix.
[0032] By impressing the voltage Ve shown in drawing 3 (b) to this ferroelectric memory apparatus, the data currently recorded are eliminated collectively.
[0033] Drawing 3 (c) is drawing for explaining the method of data writing similarly. the 1st line 19 of the selection cell of a X line group as shows data writing to drawing 3 (c) using 1 / the 3 driving method -- voltage Vw -- impressing -- the 1st line 19 of a non-choosing cell -- voltage 1/3Vw -- impressing -- and the selection cell of a Y line group -- 0V -- un--- it is alike and destructive degradation at the time of data writing is prevented so that the voltage of selection cell 2/3Vw may be impressed About this destructive degradation, by the driving method mentioned above using the PZT thin film, even if it integrates to 1Gbit by the memory cell of one mat, it is checking that a cell is not destroyed at the time of data writing.
[0034] Drawing 3 (e) is drawing for explaining a data read-out method similarly. Here, the 1st line 19 other than 1st [of a selection line] line 19a is grounded. Moreover, the 2nd line 20 other than 2nd [of a selection data line] line 20a shall be grounded.
[0035] At this time, 2nd line 20a of a selection data line is beforehand grounded by the electric discharge switch 6, and the capacity 8 for feedback is connected to the differential amplifier 7. Here, since one side of a difference input is grounded, an input impedance is held by artificial ground "0" and the differential amplifier 7 does not carry out the pressure up of the potential of 2nd line 20a of a selection data line by it. For this reason, the charge from a non-choosing cell is not poured in. Therefore, since non-interfering data read-out is made and it is the differential amplifier 7 of capacity 8 feedback, Output Vout is the memory cell capacity Cs. Feedback capacity Cr It is decided by the ratio. therefore, Vout =-(Cs/Cr) * Vr -- here -- "0" and "1" state -- as Vc0 and Vc1 -- Vc1=-(Cs1/Cr) * VrVc0=-(Cs0/Cr) * Vr -- this situation is shown in drawing 3 (f) In this drawing, the vertical axis was drawn by -V so that intelligibly. Here, from Vc1>Vc0, although read-out of information is possible, this difference is as small as 20%, and since this Cs0 changes by temperature, the holding time, etc., a dummy cell is used.
[0036] Next, as shown in drawing 4 , the composition which consists of the 1st differential amplifier 7, memory cell 1, and capacity 8 which were shown in drawing 2 , and the composition which becomes the input edge of another side from the 2nd differential amplifier 17, dummy cell 11, and capacity 18 are connected to one input one end of the 3rd differential amplifier 10.
[0037] It is Vref which the voltage of A points sets a vertical axis as -V, and serves as order of Vc0<Vref <Vc1 among drawing by this composition. It chooses. That is, Vref A dummy cell 11 is chosen so that it may become this range. For example, if the feedback capacity of capacity 8 and capacity 18 is doubled correctly, the area of a dummy cell 11 will be changed, and it is Vref. It doubles so that it may become. For example, it is the same in Vr, then is [Equation 1].

$$C_{s1} > C_{ref} > C_{s0}$$

から

$$C_{s0} = A f_s * C\hat{}_{s0}$$

$$C_{ref} = A f_{ref} * C\hat{}_{s0}$$

ここで、C_{s0}は単位面積あたりの容量である。

$$C_{ref} = C_{s0} + (C_{s1} - C_{s0}) / 2$$

$$A f_{ref} = [C_{s0} + (C_{s1} - C_{s0}) / 2] C\hat{}_{s0}$$

[0038] This means making area of a dummy cell large 0 time as many (Cs1-Cs0) / 2Cs of a memory cell as this. For example, if it is the cell of 1 micrometer**, when (Cs1-Cs0) / Cs0 is 20%, (Cs1-Cs0) / 2Cs0 is 10%, and corresponds to the cell of 1.1 micrometer**.
[0039] In this case, the data writing of a dummy cell is not performed. In actual device creation, since one fifth of steppers are used, a relative process tolerance may reach to an extreme. It is referred to as 0.01 micrometers in 1-micrometer process, and dispersion in this process tolerance is 2% in the area of 1 micrometer**, and the fall of the noise margin by dispersion in a processing size is expected to be one fifth.
[0040] That is, if 16Mbit memory uses this operation form using the cell of 1 micrometer**, it can manufacture easily by two mask number of sheets. That is, lower electrodes, such as platinum, are processed into the semiconductor substrate (wafer) which created MOS and the pie Poral element in the shape of a stripe, and ferroelectric thin films,

such as PZT, are formed after that. It is made to complete using a device, aluminum wiring, etc. which furthermore formed the up electrode, processed it so that it might go direct mostly with a lower electrode, formed the protective coat between layers in this upper part, formed the through hole for wiring, and were formed in Si wafer.
[0041] For this reason, like the conventional DRAM, there is also no need for creation of a complicated cell capacity, and there is also no need for the polysilicon contest process of two-layer [like Flash memory] or three layers. It has the merit which can create the cell of 1 micrometer** by the manufacturing technology which makes 1 micrometer a process tolerance. Moreover, it is possible to raise a 4 times as many degree of integration as this by there being also no additional process and setting a process tolerance to 0.5 micrometers.
[0042] Moreover, since the memory cell of this operation form does not contain an active element like an MOS transistor, the base to form is not limited. That is, it can form also in tops other than a silicon substrate like a glass plate. In this case, a circumference circuit becomes a TFT device. Moreover, if the low-temperature process of ferroelectric material is attained, on aluminum wiring, a simple matrix can be created and, for a whole surface **** stuffing **** reason, a degree of integration can be further raised for a drive circuit. Moreover, a circuit element can be multilayered to three-fold [a duplex and].
[0043] Thus, the memory apparatus of a multilayer and this laminated operation form becomes possible [the non-volatile memory of 128Mbit] even for a 1-micrometer process tolerance (1-micron rule). If a 0.5-micron rule [**** / still] is used, it will become realizable / the non-volatile memory of 512Mbit /.
[0044] With this operation form, it was restrained on the occasion of the conventional memory formation, for example, it becomes possible to include a control circuit like smart memory card, a microprocessor, etc. in the interior of an element.
[0045] Using the memory cell mentioned above, when constituted to equipment, a concrete example is shown in drawing 5 . The X selection circuitry 22, the Y selection circuitry 23, the sense circuit 24, a dummy cell 25 for reference, a pulse generator 25 elimination, writing, and for read-out of data, and a pulse generator 26 for elimination / writing of data are consisted of by the memory cell mat 21 with which simple matrix arrangement was carried out and two or more memory cells were constituted here.
[0046] Next, the un-destroying type ferroelectric memory apparatus and its drive method of the 2nd operation form are explained.
[0047] The example of composition of the ferroelectric memory apparatus of the 2nd operation form is shown in drawing 6 , and it explains to it. The fundamental composition of the 2nd operation form is the same as the 1st operation form, and a different point is explained. Although the sense amplifier system in the 1st operation form mentioned above was symmetrical structure, the memory cell 1 and the dummy cell 11 are unsymmetrical. For this reason, the memory cell 1 and the dummy cell 11 had the need of creating separately.
[0048] For example, if two memory cell mats containing a dummy cell 11 are prepared and these are arranged symmetrically, a changeover switch can constitute symmetrically. However, this method differs from the clinch bit-line method currently generally used by DRAM etc. This clinch bit-line method is a method used in order to make in agreement strictly the parasitism load-carrying capacity of the data line. The method of this operation gestalt does not have this need for data read-out by capacity feedback. Since a cell array is constituted from a field in which the lower part and the upper part crossed apart from Si device, it becomes that it is far more advantageous also from the point of a degree of integration to arrange a dummy cell inside a cell array also from the point of a process rather than it arranges a dummy cell independently. This operation gestalt uses a required selection circuitry and a required pulse generator effectively while it simplifies composition and raises storage capacity.
[0049] The ferroelectric memory cell used for this operation form forms an up stripe electrode in the upper part of a ferroelectric thin film, and forms the lower stripe electrode of the direction which intersects perpendicularly with the lower part mostly in the direction of a stripe of an up stripe electrode. It is the ferroelectric memory cell array by which the field of the ferroelectric thin film inserted by the upper part and the lower stripe electrode has been arranged by this composition at the simple matrix, and the dummy cell was prepared in the cell array by it.
[0050] And as shown in drawing 6 , it connects with the ferroelectric memory cell array mentioned above through the Y selecting switch 32 for choosing the 2nd line (Y lines) as (+) input one end of the differential amplifier 37 which has the feedback capacity 38. Pulse-generator 40a is connected to a ferroelectric memory cell array through the X selecting switch 39 which chooses the 1st line (X lines). (-) input one end of the differential amplifier 37 is grounded. And the outgoing end of the differential amplifier 37 is connected to the end of the input edge of the differential amplifier 10, and the differential amplifier 47 and the Y selecting switch 42 which are constituted like a differential-amplifier 37 side, a ferroelectric memory cell array, the X selecting switch 49, and pulse-generator 40b are connected to the other end. Moreover, the ferroelectric capacity for reference is connected between the 1st electrode line 33 and a pulse generator 37. The ferroelectric capacity for reference is connected with the 2nd electrode line 43 between pulse

generator 42b. In addition, a pulse generator 37 and a pulse generator 42 may be the same.
[0051] The detailed example constituted in the memory apparatus using such a ferroelectric memory cell is explained in the 5th operation gestalt mentioned later.
[0052] Next, the un-destroying type ferroelectric memory apparatus and its drive method of the 3rd operation gestalt are explained.
[0053] The example which used for the actual equipment configuration the ferroelectric memory cell constituted possible [data / which were explained with the 1st operation gestalt / write-in read-out] as the 3rd example is shown in drawing 7 . Here, the ferroelectric memory cell (memory cell mat) used with this operation gestalt attaches and explains the same reference mark to a part equivalent [to the composition of the 2nd operation gestalt by which simple matrix composition was carried out] and equivalent to the part indicated by drawing 3 or drawing 5 .
[0054] This memory cell mat 21 consists of ferroelectric capacity 1, and the up electrode line 19 and the lower electrode line 20, and consists of pulse generators 26 and 27 of the X selection circuitry 22, the Y selection circuitry 23, the sense circuit 24, the dummy cell 28 for reference, and ** elimination, writing, and for read-out. Here, it consists of switching devices 50 for carrying out package elimination of the inside of a memory cell mat.
[0055] The aforementioned Y selection circuitry 23 chooses the data line, it is the circuit which gives the pulse of data writing or elimination, and a sense amplifier 24, the cell 28 for reference, and a pulse generator 27 are connected to each of two or more Y electrode lines. It becomes possible to read the memory information on the part of a data line, and a high-speed data transfer rate is obtained by this.
[0056] Next, other examples of composition in this operation form are shown in drawing 8 . Here, it consists of pulse generators 36 of the memory cell mat 21 which consisted of simple matrices, the X selection circuitry 22, the Y selection circuitry 23, the sense circuit 24, the dummy cell 28 for reference, and ** elimination, writing, and for read-out. The pulse generator 36 with a sense amplifier 24 and the cell 28 for reference is connected to each of two or more Y electrode lines.
[0057] The un-destroying type ferroelectric memory apparatus and its drive method as the 4th operation form are explained below.
[0058] The example which used for the actual equipment configuration the ferroelectric memory cell constituted possible [data / which were explained to drawing 9 (a) with the 1st operation form mentioned above / write-in read-out] is shown. Here, the same reference mark is given to a part equivalent to the part shown in drawing 7 and drawing 8 by the part of this operation form, and the explanation is omitted. Here, the ferroelectric memory cell (memory cell mat) used with this operation form is equivalent to the composition of the 2nd operation form by which simple matrix composition was carried out, consists of ferroelectric capacity 1, and the up electrode line 19 and the lower electrode line 20, and consists of pulse generators 26 and 27 of the X selection circuitry 22, the Y selection circuitry 23, the sense circuit 24, the dummy cell 28 for reference, and ** data elimination, writing, and for read-out.
[0059] Furthermore, the package SW elements 50a and 50b for carrying out package elimination of the data in the memory cell mat 21 are formed, respectively between the memory cell mat 21, and the X selection circuitry 22 and the Y selection circuitry 23.
[0060] the total connected to the lower electrode line (2nd electrode line) 20 of settled two or more units as this operation form was shown in drawing 9 (b) -- the Y selection SW23 was formed between SW element 50b (not shown) and the reference dummy cell 28, and the pulse generator 27 for reference is formed further By this, to two or more electrode lines, it can constitute from one sense system and a pattern design becomes very easy. For example, if X lines is made into 512 when one mat is 64KB of byte composition, composition will become possible with one sense amplifier 128.
[0061] The un-destroying type ferroelectric memory apparatus and its drive method as the 5th operation form are explained below. The fundamental composition of the 5th operation form is the same as the 2nd operation form mentioned above, drawing 10 (a) is composition equivalent to the composition which showed basic composition and was shown in drawing 4 of the 1st operation form, and drawing 10 (b) is the modification which used as the base composition shown in drawing 6 . In this operation form, with the 1st operation form, since the memory cell 1 and the dummy cell 17 are created separately, two memory cell mats containing a dummy cell 17 are prepared like the case of the 2nd operation form, and these are arranged symmetrically. Of course, unlike the clinch bit-line method used by DRAM etc., there is no need of making the parasitism load-carrying capacity of the data line in agreement with this operation form for read-out by capacity feedback. While only simplifying composition and raising storage capacity, a required selection circuitry and a pulse generator are used effectively.
[0062] As shown in drawing 10 (b), two or more ferroelectric thin film capacity 1a is connected to the input side of the differential amplifier 7. Simple matrix structure of such ferroelectric thin film capacity 1a is inserted and carried out by the 1st electrode (X electrode line 19) and the 2nd electrode (Y electrode line 20) which intersect perpendicularly

mutually. The memory cell 1 of plurality [line / Y electrode / 20] and one dummy cell 11a are connected to the input side of the differential amplifier 7. On the other hand, it connects with the input side of the differential amplifier 17 at two or more memory cell 1b and one dummy cell 11b.

[0063] Here, the same capacity is sufficient as the efficiency addition capacity 51 and 52, and they may differ. With actual composition, the up electrode 19 and the up electrode 53 are symmetrically connected to a sense system including the sense circuit 24. There may not be SW or the differential amplifier 17 between the up electrode 19 and the up electrode 53 here. The up electrode 53 constitutes a simple matrix so that it may go direct mostly with the electrode line 13 which makes a pair. A simple matrix is constituted so that dummy cells 11a and 11b may also go direct mostly with the electrode line 18 or the electrode line 53. Operation of the memory apparatus which will come is explained with reference to drawing 10 (d) and (e). Dummy cell 11b is used at the time of detection of cell 1b on the right-hand side of a sense system, and the pulse generator connected to the electrode of the electrode line 1, the electrode line 13, and dummy cells 11a and 11b so that dummy cell 11b may be used is controlled at the time of detection of cell 1b on the right-hand side of a sense system.

[0064] Since the efficiency addition capacity 51 and 52 becomes the same and the load of a sense amplifier becomes the same when [this] the number of the dummy ferroelectric capacity 11a and 11b connected to the electrode line 52 connected to the electrode line 19 connected to the aforementioned differential amplifier 7 and the differential amplifier 17 may be the same, the timing of the signal which appears and appears in the differential amplifier becomes the same, and it is convenient.

[0065] The un-destroying type ferroelectric memory apparatus and its drive method as the 6th operation form are explained below. The fundamental composition of the memory apparatus of this operation form is the same as the 5th operation form mentioned above, and is the modification.

[0066] The composition of the ferroelectric memory apparatus of the 6th operation form is shown in drawing 11 . In this ferroelectric memory apparatus, it faces across the sense circuit 63 and the memory cell mats 60a and 60b are formed in the Y selection circuitries 62a and 62b and a pan. The X selection circuitries 61a and 61b are formed in the aforementioned memory cell mats 60a and 60b, and the pulse generator 65 is connected to them at X and Y selection circuitry, respectively. Therefore, the memory cell mats 60a and 60b are symmetrically arranged across the sense circuit 63. In such composition, Y selection-signal line may connect a sense circuit to one, respectively, and may summarize the electrode whose some settled by Y selection. At least one pulse generator 65 is required.

[0067] The un-destroying type ferroelectric memory apparatus and its drive method as the 7th operation form are explained below.

[0068] The composition of a memory apparatus is shown for the 7th operation form in drawing 12 . This memory apparatus faces across the sense circuits 63a-63n, and is the memory cell mat 60a1, 60b1 -60an, and 60bn, respectively to the Y selection circuitry 62a1, 62b1 -62an, 62bn, and a pan. It is prepared. aforementioned memory cell mat 60a1 - 60an and 60b1 -60bn **** -- the X selection circuitries 61a and 61b are formed, respectively, and the pulse generator 65 is connected to X and Y selection circuitry

[0069] This operation form has composition to which the laminating of the equipment of the 5th operation form was carried out in circuit. this composition -- setting -- the sense circuits 63a-63n -- inserting -- the Y selection circuitry 62a1, 62b1 -62an, and 62 -- bn 32, and the memory cell mat 60a1, 60b1-60an and 60bn It has two or more composition units mostly constituted by the symmetry.

[0070] The composition shown in drawing 13 is the modification of the 7th operation form, and the electrode lines 19a and 19b are share-ized per composition of the direction of Y, and they are dummy cell 11a1 -11an and 11b1 -11bn. It has share-ized per composition of the direction of Y.

[0071] Next, with reference to drawing 14 , the un-destroying type ferroelectric memory apparatus and its drive method as the 8th operation form are explained. The writing of the data of this memory apparatus and the method of read-out are the same as that of (c) from drawing 3 (a).

[0072] In the ferroelectric random-access memory constituted by the simple matrix which makes a storage cell ferroelectric thin film capacity pinched by the upper part of the couple which intersects perpendicularly mutually, and the lower electrode The 1st pulse (pulse for elimination) which has the larger voltage Ve than the anti-voltage Vc of the aforementioned ferroelectric thin film is impressed and polarized in the 1st polarization state of the two states of spontaneous polarization in a ferroelectric thin film (polarization). Next, the domain which impresses the 2nd pulse (pulse for writing) which has the voltage Vw with an absolute value with the aforementioned applied voltage Ve smaller than Ve of reversed polarity, and has polarization of the 1st direction of the above, The 1st direction of the above is a method which memorizes information in the state of partial polarization which the domain which has the 2nd polarization of an opposite direction mixed.

[0073] As this operation form is shown in drawing 14 , the memory cell mat of the whole chip is constituted per one

lump's record called one or more sectors 66, and at least one or more memory cells 28 for reference (dummy cell) are formed in this sector 66. The data in this memory cell are eliminated collectively.
[0074] Moreover, in drawing 14 , a memory cell and the data writing to a dummy cell may be put in block per sector, and may be performed. Data read-out in a sector 66 makes random access possible. Moreover, you may be a nonvolatile memory chip with the sector 66 and the sector control circuit 67 of the plurality in 1 chip.
[0075] Moreover, as shown in drawing 15 , into each sector 40, you may constitute from the memory cell mat 21, the X selection circuitry 21, the Y selection circuitry 23, a sense circuit 24, at least one dummy cell 28, and a control circuit 26.
[0076] As furthermore shown in drawing 16 , it can use for the memory apparatus with the output terminal 71 for [of two or more chips, the bus line 68 and the I/O circuit 69 containing a memory cell mat, a control circuit 70, and the exterior] carrying out the in-and-out force in which desorption is possible, for example, memory card. Next, with reference to drawing 17 , the un-destroying type ferroelectric memory apparatus and its drive method as the 9th operation form are explained.
[0077] The method with which this memory apparatus performs the writing and read-out of data is the same as that of (c) from drawing 3 (a), and this composition is the same as the 8th operation form.
[0078] In drawing 17 , it consists of blocks 72 containing two or more sectors 66, and one chip consists of two or more blocks 72.
[0079] Moreover, package elimination is carried out by the package elimination circuit 73 per block, block 72 performs data writing in each sector 66 unit, random access of the data read-out may be carried out, and it may be performed. Moreover, package elimination of the block 72 is carried out by the package elimination circuit 73 per block, it writes in in each sector 66 unit, and package read-out of the read-out may be carried out similarly.
[0080] Next, with reference to drawing 18 , the un-destroying type ferroelectric memory apparatus and its drive method as the 10th operation form are explained.
[0081] This memory apparatus of the writing of data and the method of read-out is equivalent to the 1st operation form, and the composition is using the 8th operation form as the base.
[0082] This memory apparatus consists of two or more X selection circuitries 22, a Y selection circuitry 75 including the function of a sense circuit, memory cell area 74 that consists of a memory cell containing a dummy cell 28, and a pulse generator 65. Per one chip or block, each sector of the X selection circuitry 22 is common, and the Y selection circuitry 75 has been independent. Moreover, it can use for the memory apparatus with two or more chip, bus lines 68, I/O circuits 65, control circuits 70, and output terminals 71 in which desorption is possible, for example, memory card.
[0083] Next, with reference to drawing 19 , the un-destroying type ferroelectric memory apparatus and its drive method as the 11th operation gestalt are explained. The method with which this memory apparatus performs the writing and read-out of data is equivalent to (c) from drawing 3 (a).
[0084] This operation gestalt is used for the memory apparatus which carried the memory section 81, the memory management function 82, and the I/O circuit 83 on one chip 80 and in which desorption is possible, for example, memory card.
[0085] The aforementioned memory management function 82 may control elimination of data, writing, and read-out for the storage region in the memory section 81 per a block or sector, and may have a JIREKU tree (address information) and keyword information in each sector unit.
[0086] Next, with reference to drawing 20 , the un-destroying type ferroelectric memory apparatus and its drive method as the 12th operation gestalt are explained. This memory apparatus is the modification which used as the base the octavus operation gestalt mentioned above, and the method which performs the writing and read-out of data is equivalent to (c) from drawing 3 (a).
[0087] In the ferroelectric random-access memory constituted by the simple matrix which makes a storage cell ferroelectric thin film capacity pinched by the upper part of the couple which intersects perpendicularly mutually, and the lower electrode The 1st pulse (pulse for elimination) which has the larger voltage Ve than the anti-voltage Vc of the aforementioned ferroelectric thin film is impressed and polarized in the 1st polarization state of the two states of spontaneous polarization in a ferroelectric thin film (polarization). Next, the domain which impresses the 2nd pulse (pulse for writing) which has the voltage Vw with an absolute value with the aforementioned applied voltage Ve smaller than Ve of reversed polarity, and has polarization of the 1st direction of the above, The 1st direction of the above is a method which memorizes information in the state of partial polarization which the domain which has the 2nd polarization of an opposite direction mixed.
[0088] The composition of this operation form consists of one chip or two or more chips, and it uses for the memory apparatus which exchanges a data signal by the electric wave generated and oscillated by the memory section 81, an antenna 85, a tuning circuit 86, a detector circuit 87, the demodulator circuit 88, the oscillator circuit 91, the

modulation circuit 90, and the control circuit 89 and in which desorption is possible, for example, memory card. Moreover, you may be the memory apparatus equipped with the voltage generating circuit 92 which takes out the voltage for driving from an electric wave in which desorption is possible. Moreover, you may be the memory apparatus which made parts other than antenna 85 form on 1 chip and in which desorption is possible, for example, memory card.

[0089] Moreover, you may be the memory apparatus which exchanges a signal by the electric wave containing an integration antenna formed into 1 chip and in which desorption is possible, for example, memory card.
[0090] Moreover, with this operation form, although the electric wave is using the millimeter wave from microwave, limitation is not carried out to this.
[0091] This operation form is a memory apparatus which uses a ferroelectric thin film as a storage, and, in addition to low driver voltage, high-speed elimination, and high speed writing, high-speed read-out, and high accumulation, has the feature which does not look at a kind except that it says un-destroying. That is, it is that the external recording device was individuated, and the mechanical component was lost, and formed high reliance, and high speed and low power-ization were achieved. A mass data carrier without the cell by the electric wave becomes realizable for the first time now. For example, the capacity of a card amounts to 256 M bytes from 4 M bytes. These can satisfy all needs.
[0092] Next, with reference to drawing 21 (a) and (b), the un-destroying type ferroelectric memory apparatus and its drive method as the 13th operation gestalt are explained. The method which the composition of this memory apparatus uses the 12th operation gestalt as the base, and performs the writing and read-out of data is equivalent to (c) from drawing 3 (a).
[0093] This operation form can equip the usual computer and a small computer with RF antenna and the microwave antenna containing the signal strange demodulator circuit used as the function of transmission and reception using the memory card shown in the 12th operation form, and can exchange data peculiar to an individual through radio. Moreover, the thing which read an individual reference number and carries out an environmental setup automatically by the electric wave from the memory card 98 which can communicate informational and which can be carried out is sufficient.
[0094] Operation is explained with reference to the flow chart of drawing 21 (b).
[0095] First, it sits down in front of the computer by which it was equipped with the function of transmission and reception (Step S1). The identification number oscillated from memory card 98 by the computer side is read (Step S2), and a computer is set as the environment set up beforehand based on an identification number (Step S3). Furthermore, from memory card 98, the information about an individual is read (step S4) and actual work is begun (Step S5). After the work end, new personal information is written in memory card 98 (Step S6), and a series of processes are ended. Moreover, again, when working, processing mentioned above only by sitting down in front of a computer is performed, and work can be begun similarly.
[0096] This operation form uses a ferroelectric thin film for a record medium, and, in addition to low-battery, high-speed elimination, and high speed writing, high-speed read-out, and high accumulation, has the feature of nondestructive read. That is, an external recording device is individuated, it is formed into high reliance, using a mechanical component as unnecessary, and high-speed processing and low consumption and low drive power-ization are realized. . Therefore, a mass data carrier without a cell becomes realizable by transforming an electric wave into a power supply and driving it. For example, the capacity of memory card amounts to 256 M bytes from 4 M bytes. These can satisfy the needs of the individual wireless card of a computer.
[0097] Next, with reference to drawing 22 , the un-destroying type ferroelectric memory apparatus and its drive method as the 14th operation form are explained. The method with which the composition of this memory apparatus performs the writing and read-out of data using the memory card indicated in the 12th operation form is equivalent to (c) from drawing 3 (a).
[0098] This operation form has the door lock 101 and the computer 102 for mount which were carried in the automobile, and RF antenna and the microwave antenna 85 which contain a signal strange demodulator circuit in navigation system 103 grade, and is the memory card 98 which can be exchanged through radio about data peculiar to an individual.
[0099] This system will perform a situation setup which carries out suitable [of the work which started by the automobile side, and performed release of a door lock 101, and starting of navigation system 103 grade, and the operator was performing conventionally] on individual level, if the operator who carries the memory card 98 which was mentioned above approaches an automobile.
[0100] According to this operation form, in addition to low-battery, high-speed elimination, and high speed writing, high-speed read-out, and high accumulation, it has the feature of nondestructive read. That is, it is that an external recording device is individuated, and form it into high reliance, using a mechanical component as unnecessary, and

high speed, a low power, and low drive power-ization are realized. Therefore, a mass data carrier without the cell by the electric wave becomes realizable. For example, the capacity of memory card amounts to 256 M bytes from 4 M bytes. These can satisfy the needs of the individual wireless file for automobiles.

[0101] Next, with reference to drawing 23 , the un-destroying type ferroelectric memory apparatus and its drive method as the 15th operation gestalt are explained. The method with which the composition of this memory apparatus performs the writing and read-out of data using the memory card indicated in the 12th operation gestalt is equivalent to (c) from drawing 3 (a).

[0102] this example has RF antenna and the microwave antenna 58 which contain a signal strange demodulator circuit in the auto-lock mechanism 104 and ID recognition equipment 105 which were carried in the door of the room, and position recognition equipment 106 grade, and is the memory card 98 which can be exchanged through radio about data peculiar to an individual.

[0103] According to this operation gestalt, the system by which only the specific person who set up beforehand can enter a room is built, and an effect equivalent to the 14th example mentioned above is acquired.

[0104] Next, with reference to drawing 24 , the un-destroying type ferroelectric memory apparatus and its drive method as the 16th operation gestalt are explained. The method with which the composition of this memory apparatus performs the writing and read-out of data using the memory card indicated in the 12th operation gestalt is equivalent to (c) from drawing 3 (a).

[0105] It has RF antenna and the microwave antenna 108 containing a signal strange demodulator circuit which were carried in automatic tailor equipment (automatic deposit and drawer equipment) 107, and is the memory card 98 which can be exchanged through radio about data peculiar to an individual.

[0106] In addition to low-battery, high-speed elimination, and high speed writing, high-speed read-out, and high accumulation, this method has the feature which does not look at a kind except that it says un-destroying using the ferroelectric. That is, it is that the external recording device was individuated, and the mechanical component was lost, and formed high reliance, and high speed and low power-ization were achieved. A mass data carrier without the cell by the electric wave becomes realizable for the first time now. For example, the capacity of a card amounts to 256 M bytes from 4 M bytes. These can satisfy the needs of the individual wireless file of account.

[0107] Next, with reference to drawing 25 , the un-destroying type ferroelectric memory apparatus and its drive method as the 17th operation gestalt are explained. The method with which the composition of this memory apparatus performs the writing and read-out of data using the memory card indicated in the 12th operation gestalt is equivalent to (c) from drawing 3 (a).

[0108] The memory apparatus shown in drawing 25 is the memory card 98 which can be exchanged through radio about data peculiar to a equipment and an individual in RF antenna and the microwave antenna 110 containing a signal strange demodulator circuit which were carried in home television, game equipment, and the home data terminal 109. This memory card 98 can be provided with various information, such as the owner's healthy situation and account information, business information, and FAX information. Therefore, according to this operation gestalt, an effect equivalent to the 15th example mentioned above can be acquired.

[0109] Next, with reference to drawing 26 , the un-destroying type ferroelectric memory apparatus and its drive method as the 18th operation gestalt are explained. The method which the composition of this memory apparatus uses the 12th operation gestalt as the base, and performs the writing and read-out of data is equivalent to (c) from drawing 3 (a).

[0110] It is the memory apparatus 98 which is constituted from the memory section 81 by which the memory cell which uses a ferroelectric thin film as a record medium is arranged, a control circuit 89, a high-speed optical modulator and the high-speed circuit photo diode 112, and an optical power generation cell 111 by the shape of a matrix which consists of one chip or two or more chips and in which desorption is possible, for example, memory card.

[0111] In the operation form mentioned above, although communicated by the electric wave, the memory card 98 of this operation form performs writing of data, and read-out by light, and the same effect as the 15th example mentioned above is acquired.

[0112] Next, with reference to drawing 27 , the un-destroying type ferroelectric memory apparatus and its drive method as the 19th operation gestalt are explained. The method with which this memory apparatus performs the writing and read-out of data is equivalent to (c) from drawing 3 (a).

[0113] In the ferroelectric random-access memory constituted by the simple matrix which makes a storage cell ferroelectric thin film capacity pinched by the upper part of the couple which intersects perpendicularly mutually, and the lower electrode The 1st pulse (pulse for elimination) which has the larger voltage Ve than the anti-voltage Vc of the aforementioned ferroelectric thin film is impressed and polarized in the 1st polarization state of the two states of spontaneous polarization in a ferroelectric thin film (polarization). Next, the domain which impresses the 2nd pulse

(pulse for writing) which has the voltage Vw with an absolute value with the aforementioned applied voltage Ve smaller than Ve of reversed polarity, and has polarization of the 1st direction of the above, The 1st direction of the above is a method which memorizes information in the state of partial polarization which the domain which has the 2nd polarization of an opposite direction mixed.

[0114] Drawing 27 shows the physical relationship of the memory cell mat 21 seen from the upper surface, and the circumference circuit 115. Moreover, drawing 28 (a) or (c) is drawing showing the process for forming this memory cell mat 21.

[0115] A ferroelectric thin film is inserted with the up electrode line 19 formed as a stripe electrode, and the lower electrode line 20 formed as a stripe electrode which intersects perpendicularly with this mostly, and a memory cell 1 is formed in the field of the inserted intersection. These memory cells 1 are arranged at a simple matrix.

[0116] This simple matrix memory cell mat 21 is formed in the upper part of the field containing a silicon oxide 121, and the circumference circuit 115 is formed in fields other than this memory matric smut 21.

[0117] Even the passivation films 122, such as PSG and BPSG, form the semiconductor substrate containing the pie Poral transistor formed beforehand or MOS transistor 124, before formation of the contact hole linked to the diffusion layer of a device, an oxide film 121 is included, for example, laminating formation is carried out in the upper layer of the passivation films 122, such as PSG and BPSG, in the order of the lower electrode line 20, the ferroelectric thin film 125, and the up electrode line 19.

[0118] Here, usually, a lower electrode line forms membranes using vacuum evaporationo equipment, a sputtering system, magnetron-sputtering equipment, etc., and performs etching processing a top using usual phot lithography and a usual dry etching system, ion etching equipment, a reactive ion etching system, an ion milling system, etc. Moreover, a ferroelectric is performed by the spin applying methods, such as a sol gel process and an organic-metal part solution method, sputtering, MOCVD, etc., and the combination which contains platinum group metals, a conductive oxide, and a glue line as a vertical electrode carries out suitable [of the material of construction]. Of course, what is necessary is just not the thing limited to these but the material which goes out by use equally. Moreover, PZT, PLZT, Bi stratified compound, etc. carry out suitable [of the ferroelectric]. A protective coat 126 is performed in the best layer.

[0119] Then, that it is simultaneous or separately, a via hole is formed in a semiconductor device 124, the vertical section electrode line 19, and 20 both sides, and they are wired in ARUNIUMUMI or aluminum with a heat-resistant barrier layer. Then, a protective coat is formed again.

[0120] Moreover, in this operation form, a circumference circuit may be formed in the surrounding field of this memory matric smut, and may be distributed according to the function in a chip.

[0121] Next, with reference to drawing 29 , the un-destroying type ferroelectric memory apparatus and its drive method as the 20th operation form are explained. The method which the composition of this memory apparatus uses the 12th operation form as the base, and performs the writing and read-out of data is equivalent to (c) from drawing 3 (a).

[0122] Drawing 29 (a) shows the physical relationship of the memory cell mat 21 and the circumference circuit 115. Moreover, drawing 29 (b) and (c) show the cross-section structure in a manufacturing process. The memory cell mat 21 of the simple matrix which used the ferroelectric thin film for the record medium is formed in the circuit upper layer which covered with the circumference circuit 115 here.

[0123] As shown in drawing 29 (b), even the passivation films 122, such as PSG and BPSG, form membranes on the semiconductor substrate containing the pie Poral transistor used as the active device formed beforehand, or MOS transistor 124, and after forming the contact hole linked to the diffusion layer of a device, one layer or two or more wiring are performed. After formation of these devices and circuits, the suitable interlayer film 128 is formed, a via hole is formed beforehand, and it forms on it in order of the lower electrode line 20, the ferroelectric thin film 125, and the up electrode line 19. The formation method and material are equivalent to the 19th operation gestalt mentioned above, and good.

[0124] Moreover, the central processing unit and digital-signal-processing equipment containing a circumference circuit or a control circuit may be formed in the active device on a semiconductor substrate.

[0125] According to this operation gestalt, since it does not have a transistor in a memory cell, a semiconductor chip can be used effectively. For example, a 32-bit central-process circuit is formed in an active element, and the laminating of the memory is carried out, and formation of 1 chip microcomputer is attained. Moreover, central-process circuit **** digital-signal-processing equipment is formed as an active element, and the laminating of the memory is carried out, and formation of the perfect-with recording device voice of one chip and an image-processing function is attained. Next, with reference to drawing 30 , the un-destroying type ferroelectric memory apparatus and its drive method as the 21st operation gestalt are explained.

[0126] In this operation gestalt, since it does not have a transistor in the memory cell, not only one layer but two or

more lamination of the memory cell mat of a ferroelectric which consists of simple matrices is attained. The laminating of the pair of two or more at least two up electrode lines 20 and lower electrode lines 19 can be carried out.
[0127] According to this operation gestalt, since a transistor is not included in a memory cell, a semiconductor chip can be used effectively. For example, a 32-bit central-process circuit is formed as an active element, and the laminating of the memory cell is carried out, and formation of 1 chip microcomputer is attained. Moreover, central-process circuit **** digital-signal-processing equipment is formed as an active element, and the laminating of the memory cell is carried out, and formation of the perfect-with recording device voice of one chip and an image-processing function is attained.
[0128] Moreover, according to this operation gestalt, integration of very huge memory is attained with a loose processing rule. Here, even with a 1-micron processing rule, in this operation gestalt, the non-volatile memory of 2Gbit (s) becomes possible from 512Mbit, and it carries out suitable [of these] to multimedia by the four-layer laminating.
[0129] Although explained based on the above operation gestalt, the following invention is also included in this specification.
[0130] (1) In the 1st which intersects perpendicularly mutually, and the ferroelectric random-access memory which makes a storage cell ferroelectric thin film capacity pinched by the 2nd electrode The 1st pulse which has the larger voltage Ve than the anti-voltage Vc of the aforementioned ferroelectric thin film is impressed and polarized in the 1st polarization state of the two states of spontaneous polarization (polarization). Next, the domain which impresses the 2nd pulse which has the voltage Vw with an absolute value with the aforementioned applied voltage Ve smaller than Ve of reversed polarity, and has polarization of the 1st direction of the above, In the method which remembers information to be the 1st direction of the above in the state of partial polarization which the domain which has the 2nd polarization of an opposite direction mixed The comparison dummy ferroelectric thin film capacity which was the same, or read memory information in un-destroying using the small positive or negative read-out pulse Vr, and was prepared apart from the aforementioned ferroelectric thin film capacity in the absolute value from Ve, The 1st differential type amplifier to which feedback was able to be applied by the capacity connected to the aforementioned ferroelectric thin film capacity, The ferroelectric memory apparatus which consisted of the 3rd differential type amplifier which inputs the output of the 2nd differential type amplifier to which feedback was able to be applied by the capacity connected to the aforementioned comparison dummy ferroelectric thin film capacity, and these differential type amplifier.
[0131] (2) In the aforementioned ferroelectric memory apparatus, have two or more aforementioned ferroelectric thin film capacitative element, and it lets the switch for selection pass to this ferroelectric thin film capacitative element. Connect with the 1st pulse generator which generates the 1st pulse for elimination, the 1st pulse for writing, and the 1st pulse for read-out, and it lets the switch for selection pass in comparison dummy ferroelectric thin film capacity. The ferroelectric memory apparatus of the aforementioned (1) publication characterized by connecting with the 2nd pulse generator which generates the 2nd pulse for elimination, and the 2nd pulse for read-out.
[0132] (2) ' In the aforementioned ferroelectric memory apparatus, have two or more aforementioned ferroelectric thin film capacitative element, and it lets the switch for selection pass to this ferroelectric thin film capacitative element. Connect with the 1st pulse generator which generates the 1st pulse for elimination, the 1st pulse for writing, and the 1st pulse for read-out, and it lets the switch for selection pass in comparison dummy ferroelectric thin film capacity. The ferroelectric memory apparatus of the aforementioned (1) publication characterized by connecting with the 2nd pulse generator which generates the 2nd pulse for elimination, the 2nd pulse for writing, and the 2nd pulse for read-out.
[0133] (3) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- a dummy cell -- area -- the -- one -- a direction -- a portion -- polarization -- a state -- capacity -- a difference -- this -- the -- one -- a direction -- capacity -- a ratio -- about -- one -- /-- two -- a memory cell -- area -- being large -- things -- the feature -- ** -- carrying out -- the above -- (-- one --) -- a publication -- a ferroelectric -- a memory apparatus --
[0134] (4) the above -- a ferroelectric -- a memory apparatus -- setting -- a dummy cell -- area -- the -- one -- a direction -- a portion -- polarization -- a state -- capacity -- a difference -- the -- one -- a direction -- capacity -- a ratio -- eight -- /-- ten -- from -- two -- /-- ten -- the range -- a memory cell -- area -- being large -- things -- the feature -- ** -- carrying out -- the above -- (-- one --) -- a publication -- a ferroelectric --
[0135] (5) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- a ferroelectric -- a thin film -- capacity -- the -- one -- differential -- type -- amplifier -- between -- the -- one -- a transfer switch -- comparison -- a dummy -- a ferroelectric -- a thin film -- capacity -- the -- two -- differential -- type -- amplifier -- between -- the -- two -- a transfer switch -- preparing -- things -- the feature -- ** -- carrying out -- the above -- (-- one --) -- a term --
[0136] (6) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- the -- one -- differential -- type -- amplifier -- one side -- an input terminal -- and -- the above -- the -- one -- a transfer switch -- one side -- a terminal -- zero -- bias -- or -- the same -- potential -- it is -- the above -- the -- two -- differential -- type -- amplifier -- one side --

an input terminal -- and -- the -- two -- a transfer switch -- one side -- a terminal -- zero -- bias
[0137] Therefore, according to the above (1) or the (6) terms, the 1st pulse 13 which has the larger voltage Ve than the anti-voltage Vc of the aforementioned ferroelectric thin film is impressed and polarized in the 1st polarization state of the two states of spontaneous polarization (polarization). Next, in the aforementioned applied voltage Ve, the 2nd pulse 14 which has the voltage Vw of reversed polarity is impressed, and the domain which has polarization of the 1st direction of the above, and the 1st direction of the above memorize information in the state of partial polarization which the domain which has the 2nd polarization of an opposite direction mixed. Although it appears as a difference of capacity, since this state has small capacity-factor deltaC/C when reading on read-out voltage, it is necessary to amplify it. If C considers temperature dependence, data-hold time dependency, etc. at this time, comparison read-out by the reference cell using ferroelectric capacity is required. Here, the bulk memory of this not destroying becomes possible in the sense circuit which combined comparison read-out by the capacity addition feedback circuit and reference cell which can read small deltaC/C without voltage change of the data line. Therefore, the un-destroying type ferroelectric memory which can realize the incoherency at the time of writing and the incoherency at the time of read-out, and destructive read, and carries out suitable to large-scale-izing and large capacity-ization in the sense circuit which combined comparison read-out by the capacity addition feedback circuit and reference cell which can read small deltaC/C without voltage change of the data line becomes realizable.
[0138] (7) The ferroelectric thin film capacity connected to the differential type amplifier of the above 1st in the aforementioned ferroelectric memory apparatus is a ferroelectric memory apparatus given in the aforementioned (1) term characterized by being plurality.
[0139] (8) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- the -- one -- differential -- type -- amplifier -- connecting -- having -- a ferroelectric -- a thin film -- capacity -- a stripe -- ** -- the upper part -- an electrode -- it -- almost -- intersecting perpendicularly -- a stripe -- ** -- the lower part -- an electrode -- crossing -- and -- the upper part -- an electrode -- a stock -- an electrode -- crossing -- these -- inserting -- having had -- a field -- it is -- simple
[0140] (9) A ferroelectric memory apparatus given in the aforementioned (8) term characterized by the line selection circuitry linked to the 1st electrode of the above, and the pulse generator connected through the aforementioned line selection circuitry in the aforementioned ferroelectric memory apparatus.
[0141] (10) A ferroelectric memory apparatus given in any 1 term of the aforementioned (7) term characterized by having the line selection circuitry connected with the 2nd electrode of the above between the 1st differential amplifier of the above in the aforementioned ferroelectric memory apparatus, and (8) terms.
[0142] (11) The 2nd ferroelectric thin film capacity connected to the differential type amplifier of the above 2nd in the aforementioned ferroelectric memory apparatus is a ferroelectric memory apparatus given in the aforementioned (1) term characterized by being plurality.
[0143] (12) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- the -- two -- a ferroelectric -- a thin film -- capacity -- an electrode -- the above -- the -- two -- the differential amplifier -- between -- connecting -- having -- a line -- a selection circuitry -- having -- things -- the feature -- ** -- carrying out -- the above -- (-- one --) -- a term -- (-- seven --) -- a term -- or -- (-- 11 --) -- a term -- some
[0144] (13) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- the -- two -- a ferroelectric -- capacity -- an electrode -- the above -- the -- two -- a pulse -- generating -- the -- two -- a pulse generator -- between -- connecting -- having -- a line -- a selection circuitry -- having -- things -- the feature -- ** -- carrying out -- the above -- (-- one --) -- a term -- (-- seven --) -- a term -- or -- (-- 11 --
[0145] (14) A ferroelectric memory apparatus given in any 1 term of the aforementioned (1) term characterized by connecting the ferroelectric capacity for reference between the electrode line of the above 1st, and the 1st pulse generator of the above in the aforementioned ferroelectric memory apparatus, (7) terms, or (13) terms.
[0146] (15) A ferroelectric memory apparatus given in any 1 term of the aforementioned (1) term characterized by connecting the ferroelectric capacity for reference between the electrode line of the above 2nd, and the 1st pulse generator of the above in the aforementioned ferroelectric memory apparatus, (7) terms, or (14) terms.
[0147] (16) A ferroelectric memory apparatus given in any 1 term of the aforementioned (1) term characterized by the 1st pulse generator of the above and the 2nd pulse generator of the above being equivalent in the aforementioned ferroelectric memory apparatus, (7) terms, or (15) terms.
[0148] Therefore, according to the aforementioned (7) term or the (16) terms, in a simple matrix, the cell for referring to the dummy is made, it is crowded, and this is driven by the same pulse driver circuit.
[0149] therefore -- easy -- manufacture -- and a pattern design can be carried out, and it is stabilized and drives
[0150] In the aforementioned ferroelectric memory apparatus further (17) A memory cell mat, The simultaneous switch connected to the 1st electrode line, and the 1st selection circuitry, A ferroelectric memory apparatus given in the

aforementioned (1) term characterized by providing the 1st pulse generator, another simultaneous switch connected with the sense amplifier at the 2nd electrode line, the 2nd pulse generator equivalent to the 1st pulse generator of the above and a reference cell, and the pulse generator for reference.

[0151] (18) the above -- a ferroelectric -- a memory apparatus -- setting -- plurality -- the above -- two -- an electrode -- a line -- respectively -- alike -- a sense amplifier -- and -- reference -- ** -- a cell -- a pulse generator -- connecting -- having had -- things -- the feature -- ** -- carrying out -- the above -- (-- 17 --) -- a term -- a publication -- a ferroelectric -- a memory apparatus .

[0152] Therefore, since according to the aforementioned (17) ****** (18) term the output of each data line was connected to the sense circuit and the dummy cell for reference of each data-line unit was arranged, a signal is read per data line.

[0153] Therefore, it becomes possible to read a lot of data at once.

[0154] (19) A ferroelectric memory apparatus given in the aforementioned (17) term characterized by having a selecting switch and a pulse generator for reference in the aforementioned ferroelectric memory apparatus between another simultaneous switches and the reference cells which were connected to the electrode line of the above 2nd.

[0155] (20) A ferroelectric memory apparatus given in the aforementioned (17) term characterized by having **********(ed) on the 2nd electrode line per plurality, and connecting a pulse generator with a sense amplifier and the cell for reference to each further in the aforementioned ferroelectric memory apparatus.

[0156] Therefore, since according to the aforementioned (19) ****** (20) term the selection circuitry was prepared in the data line of the unit of an arbitrary number, the output was connected to the sense circuit and the dummy cell for reference of the data line of the unit of an arbitrary number was arranged, the data line is chosen and a signal is read.

[0157] Therefore, it becomes possible to read a lot of data, such as a byte unit, at once. Moreover, the pattern design of a sense circuit becomes possible.

[0158] (21) the above -- a ferroelectric -- a memory apparatus -- setting -- further -- the above -- the -- one -- the differential amplifier -- connecting -- having -- the -- one -- an electrode -- a line -- the -- two -- the differential amplifier -- connecting -- having -- the -- two -- an electrode -- a line -- plurality -- a memory cell -- a ferroelectric -- capacity -- at least -- one -- a ** -- more than -- a dummy -- a ferroelectric -- capacity -- connecting -- having had -- things -- the feature -- ** --

[0159] (22) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- the -- one -- the differential amplifier -- connecting -- having -- the -- one -- an electrode -- a line -- the above -- the -- two -- the differential amplifier -- connecting -- having -- the -- two -- an electrode -- a line -- respectively -- connecting -- having had -- a memory cell -- a ferroelectric -- capacity -- a number -- being the same -- things -- the feature -- ** -- carrying out -- the above -- (-- 21

(23) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- the -- one -- the differential amplifier -- connecting -- having -- the -- one -- an electrode -- a line -- the above -- the -- two -- the differential amplifier -- connecting -- having -- the -- two -- an electrode -- a line -- respectively -- alike -- connecting -- having had -- a dummy -- a ferroelectric -- capacity -- a number -- being the same -- things -- the feature -- ** -- carrying out -- the above -- (

[0160] (24) At the time of read-out of the information on the memory cell ferroelectric capacity connected to the 1st electrode line connected with the 1st differential amplifier of the above in the aforementioned ferroelectric memory apparatus Comparison read-out is performed using the dummy ferroelectric capacity connected to the 2nd electrode line connected to the 2nd differential amplifier of the above. At the time of read-out of the memory cell ferroelectric capacity connected to the 2nd electrode line connected to the 2nd differential amplifier of the above A ferroelectric memory apparatus given in the aforementioned (21) term characterized by performing comparison read-out using the dummy ferroelectric capacity connected to the 1st electrode line connected to the 1st differential amplifier of the above.

[0161] (25) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- the -- one -- the differential amplifier -- connecting -- having -- the -- one -- an electrode -- a line -- the -- three -- an electrode -- a line -- almost -- going direct -- simple -- a matrix -- forming -- the above -- the -- two -- the differential amplifier -- connecting -- having -- the -- two -- an electrode -- a line -- the -- four -- an electrode -- a line -- almost -- going direct --

[0162] (26) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- a dummy -- a ferroelectric -- capacity -- the -- one -- an electrode -- a line -- almost -- having gone direct -- the -- three -- an electrode -- an intersection -- ****** -- giving -- having -- the above -- a dummy -- a ferroelectric -- capacity -- the -- two -- an electrode -- a line -- almost -- having gone direct -- others -- an electrode -- an intersection -- ****** -- giving -- having -- things

[0163] Therefore, according to the aforementioned (21) ****** (26) term, the cell of double precision can be read in

one sense circuit by creating and comparing a memory cell with a reference memory cell in two simple matrices.
[0164] Therefore, since data-line capacity is the same, the design of a sense amplifier can be performed easily and sense amplifier area can be used effectively.
[0165] (27) the above -- a ferroelectric -- a memory apparatus -- setting -- further -- plurality -- X -- a selection circuitry -- Y -- a selection circuitry -- a memory cell -- a mat -- a pulse generator -- a sense amplifier -- constituting -- having -- a sense amplifier -- inserting -- Y -- a selection circuitry -- a memory cell -- a mat -- almost -- ** -- constituting -- having had -- things -- the feature -- ** -- carrying out -- the above -- (-- one --) -- a term -- a publication -- a ferroelectric -- a memory apparatus .
[0166] Therefore, according to the aforementioned (27) term, by placing a memory cell symmetrically through a sense amplifier, it is efficient and arrangement of a memory mat is attained at an effective area.
[0167] Therefore, it becomes possible to take large bit density.
[0168] (28) A ferroelectric memory apparatus given in the aforementioned (27) term which sandwiches the aforementioned sense amplifier and is characterized for the composition unit from which Y selection circuitry and the memory cell mat were mostly constituted by ** by two or more hampers in the aforementioned ferroelectric memory apparatus.
[0169] (29) A ferroelectric memory apparatus given in the aforementioned (28) term characterized by consisting of simple matrices inserted into the vertical electrode to which the 1st memory cell, the 1st dummy cell and the 2nd memory cell, and the 2nd dummy cell go direct mostly mutually in the aforementioned ferroelectric memory apparatus.

[0170] Therefore, according to the aforementioned (28) ****** (29) term, X selection circuitry is share-ized for a memory cell, and Y selection circuitry and a sense amplifier are divided, and distribution of a function is attained. The cell for reference can be created simultaneously.
[0171] Therefore, bit density is raised and it becomes possible to achieve advanced features.
[0172] (30) In the ferroelectric memory apparatus which makes a storage cell ferroelectric thin film capacity pinched by the electrode of a couple The 1st pulse which has the larger voltage Ve than the anti-voltage Vc of the aforementioned ferroelectric thin film is impressed and polarized in the 1st polarization state of the two states of spontaneous polarization (polarization). Next, the domain which impresses the 2nd pulse which has the voltage Vw with an absolute value with the aforementioned applied voltage Ve smaller than Ve of reversed polarity, and has polarization of the 1st direction of the above, the method which remembers information to be the 1st direction of the above in the state of partial polarization which the domain which has the 2nd polarization of an opposite direction mixed -- setting -- the aforementioned ferroelectric memory cell -- and The memory cell for reference consists of simple matrices by the electrode of the couple which goes direct mostly. the memory cell mat of the whole chip It is the ferroelectric memory apparatus characterized by being constituted per one lump's record called one or more sectors, arranging at least one or more memory cells for reference at this sector, putting in block the inside of this memory cell, and making elimination.
[0173] (31) A ferroelectric memory apparatus given in the aforementioned (30) term characterized by for the writing of the aforementioned ferroelectric memory cell and the memory cell for reference bundling up per sector, and performing it in the aforementioned ferroelectric memory apparatus.
[0174] (32) It is a ferroelectric memory apparatus given in the aforementioned (30) term characterized by the ability of read-out in the aforementioned sector to carry out random access in the aforementioned ferroelectric memory apparatus.
[0175] (33) A ferroelectric memory apparatus given in the aforementioned (30) term further characterized by being a nonvolatile memory chip with two or more sectors and sector control circuits into 1 chip in the aforementioned ferroelectric memory apparatus.
[0176] (34) the above -- a ferroelectric -- a memory apparatus -- setting -- each -- a sector -- **** -- a memory cell -- a mat -- X -- selection -- a sense -- a circuit -- Y -- selection -- a sense -- a circuit -- at least -- one -- a ** -- a dummy cell -- and -- a control circuit -- having -- things -- the feature -- ** -- carrying out -- the above -- (-- 31 --) -- a term -- a publication -- a ferroelectric -- a memory apparatus .
[0177] (35) the above -- a ferroelectric -- a memory apparatus -- setting -- plurality -- a chip -- a bus line -- I/O -- a circuit -- a control circuit -- an output terminal -- having -- desorption -- being possible -- a memory apparatus -- for example, -- memory card -- it is -- things -- the feature -- ** -- carrying out -- the above -- (-- 33 --) -- a term -- (-- 34 --) -- a term -- some -- one -- a term -- a publication -- a ferroelectric -- a memory apparatus .
[0178] Therefore, according to the aforementioned (30) term or the (35) terms, the smallest unit of memory is sector-ized and it considers as the unit of elimination and writing in it.
[0179] Therefore, the un-destroying nature at the time of non-interfering writing and writing is guaranteed.

[0180] (36) the above -- a ferroelectric -- a memory apparatus -- setting -- plurality -- a sector -- containing -- a block -- constituting -- having -- **** -- one -- a chip -- plurality -- a block -- constituting -- having had -- things -- the feature -- ** -- carrying out -- the above -- (-- 30 --) -- a term -- a publication -- a ferroelectric -- a memory apparatus .
(37) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- a block -- a unit -- information -- a package -- elimination -- carrying out -- having -- each -- a sector -- a unit -- information -- writing -- carrying out -- information -- read-out -- random access -- carrying out -- having -- things -- the feature -- ** -- carrying out -- the above -- (-- 36 --) -- a term -- a publication -- a ferroelectric -- a memory apparatus .
[0181] (38) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- a block -- a unit -- information -- a package -- elimination -- carrying out -- having -- each -- a sector -- a unit -- information -- writing -- carrying out -- information -- read-out -- a package -- read-out -- carrying out -- having -- things -- the feature -- ** -- carrying out -- the above -- (-- 36 --) -- a term -- a publication -- a ferroelectric -- a memory apparatus .
[0182] Therefore, according to the aforementioned (36) term or the (38) terms, the smallest unit of elimination is blocked, the smallest unit of writing of memory is sector-ized, and information is read.
[0183] Therefore, the un-destroying nature at the time of non-interfering writing and writing is guaranteed.
[0184] (39) In the aforementioned ferroelectric memory apparatus, consist of two or more X selection circuitries and Y selection circuitries, a memory cell mat, a pulse generator, and a sense amplifier, and insert the aforementioned sense amplifier. Y -- a selection circuitry -- a memory cell -- a mat -- almost -- the symmetry -- arranging -- having -- one -- a chip -- or -- a block -- a unit -- each -- a sector -- X -- a selection circuitry -- common -- Y -- a selection circuitry -- becoming independent -- arranging -- having -- things -- the feature -- ** -- carrying out -- the above -- (-- 30 --) -- a term -- and -- (-- 36 --) -- a term -- some -- one -- a term -- a publication --
[0185] (40) the above -- a ferroelectric -- a memory apparatus -- setting -- plurality -- a chip -- a bus line -- I/O -- a circuit -- a control circuit -- an output terminal -- having -- desorption -- being possible -- a memory apparatus -- for example, -- memory card -- it is -- things -- the feature -- ** -- carrying out -- the above -- (-- 37 --) -- a term -- or -- (-- 39 --) -- a term -- some -- one -- a term -- a publication -- a ferroelectric -- a memory apparatus .
[0186] Therefore, according to the aforementioned (39) ****** (40) term, it considers as the unit of elimination by considering a memory cell field common to X selection as a block, and considers as the unit of writing by making Y selection of a certain unit into a sector.
[0187] Therefore, bit density is raised and it becomes possible to achieve advanced features.
[0188] (41) A ferroelectric memory apparatus given in any 1 term of the aforementioned (37) term characterized by being the memory apparatus with the memory section, the memory management function, and the I/O circuit in which desorption is possible, for example, memory card, in the aforementioned ferroelectric memory apparatus at one chip, or (39) terms.
[0189] (42) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- memory -- management -- a function -- memory -- circles -- a block -- or -- a sector -- a unit -- a storage cell -- receiving -- information -- elimination -- writing -- read-out -- a function -- controlling -- each -- a sector -- a unit -- a directory (address information) -- a keyword -- information -- having -- things -- the feature -- ** -- carrying out -- the above -- (-- 41 --) -- a term
[0190] (43) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- a control circuit -- MPU -- constituting -- having -- **** -- memory -- circles -- a block -- or -- a sector -- a unit -- a storage cell -- receiving -- information -- elimination -- writing -- read-out -- a function -- controlling -- each -- a sector -- a unit -- a directory (address information) -- a keyword -- information -- having had -- things -- the feature -- ** -- carrying out -- the above -- (-- 40
[0191] Therefore, according to the aforementioned (41) term or the (43) terms, a directory manages a sector and the operating condition of a block, and it becomes easy to use memory.
[0192] Therefore, mass memory becomes usable simply.
[0193] (44) It has a storage cell for the ferroelectric thin film capacity pinched by the electrode of a couple. The aforementioned storage cell impresses and polarizes the 1st pulse which has the larger voltage Ve than the anti-voltage Vc of the aforementioned ferroelectric thin film in the 1st polarization state of the two states of spontaneous polarization (polarization). Next, the domain which impresses the 2nd pulse which has the voltage Vw with an absolute value with the aforementioned applied voltage Ve smaller than Ve of reversed polarity, and has polarization of the 1st direction of the above, In the ferroelectric memory apparatus which remembers information to be the 1st direction of the above in the state of partial polarization which the domain which has the 2nd polarization of an opposite direction mixed The memory section and the antenna which are carried in one chip or two or more chips, a tuning circuit, The memory apparatus which consists of a detector circuit, a demodulator circuit, an oscillator circuit, a modulation circuit, and a control circuit, and exchanges a signal through radio and in which desorption is possible, for example, the

ferroelectric memory apparatus characterized by being memory card.
[0194] (45) A ferroelectric memory apparatus given in the aforementioned (44) term which has the circuit which generates the voltage for driving, and power, and is characterized by being the memory apparatus in which desorption is possible in the aforementioned ferroelectric memory apparatus from the electric wave to receive.
[0195] (46) the above -- a ferroelectric -- a memory apparatus -- setting -- the above -- an antenna -- except -- a part -- one -- a chip -- carrying -- an electric wave -- information -- a signal -- exchanging -- desorption -- being possible -- a memory apparatus -- it is -- things -- the feature -- ** -- carrying out -- the above -- (-- 44 --) -- ****** -- (-- 45 --) -- a term -- some -- one -- a term -- a publication -- a ferroelectric -- a memory apparatus .
[0196] (47) A ferroelectric memory apparatus given in any 1 term of the aforementioned (44) ****** (45) term characterized by carrying the aforementioned antenna on the aforementioned 1 chip in the aforementioned ferroelectric memory apparatus.
[0197] (48) It is a ferroelectric memory apparatus given in any 1 term of the aforementioned (44) term characterized by the aforementioned electric wave being the memory apparatus which is a millimeter wave from microwave, and in which desorption is possible, for example, memory card, in the aforementioned ferroelectric memory apparatus, and (45) ****** (47) term.
[0198] therefore -- according to the aforementioned (44) term or (48) terms -- this method of a ferroelectric -- a low battery -- and low power and mass memory are possible, and it tears and appears in the application in which a lot of data communication is possible through radio This advantage can be pulled out by using an electric wave (RF) circuit.
[0199] Therefore, the data carrier in which a lot of data communication is possible through radio becomes possible.
[0200] (49) A ferroelectric memory apparatus given in the aforementioned (44) term characterized by being the memory card which can be exchanged through radio about data peculiar to an individual to the computer which was able to prepare RF antenna containing a signal strange demodulator circuit, and the microwave antenna in the aforementioned ferroelectric memory apparatus.
[0201] (50) A ferroelectric memory apparatus given in the aforementioned (49) term which reads an individual reference number in the aforementioned memory card which can be exchanged through radio in the aforementioned ferroelectric memory apparatus, and is characterized by the thing which carry out an environmental setup automatically, and which can be carried out at a computer.
[0202] Therefore, according to the aforementioned (49) ****** (50) term, a lot of data communication and extensive memory by the electric wave (RF) are the the best for the individual data card of a computer. a personal hard disk -- the time -- the former -- having been difficult -- although -- this method -- using -- since -- being possible -- becoming .
[0203] Therefore, any computers become usable just like the machine only for themselves with an individual database.
[0204] (51) A ferroelectric memory apparatus given in the aforementioned (44) term characterized by being the memory card which can be exchanged through radio about data peculiar to an individual to the system containing the computer for mount and navigation system which control the power-door-lock function carried in an automobile in which RF antenna containing a signal strange demodulator circuit and the microwave antenna were prepared in the aforementioned ferroelectric memory apparatus, and a run.
[0205] Therefore, according to the aforementioned (51) term, a lot of data communication and extensive memory by the electric wave (RF) are the the best for the individual data card of an automobile. By mass data and CPU, conventionally, since possession of difficult ID, security, and exclusive data uses this method, it becomes possible.
[0206] Therefore, since possession of ID, security, and exclusive data uses this method, it becomes possible.
[0207] (52) A ferroelectric memory apparatus given in the aforementioned (44) term characterized by being the memory card which can be exchanged through radio about data peculiar to an individual to the system containing ID recognition equipment which was carried in the aforementioned automobile in which RF antenna containing a signal strange demodulator circuit and the microwave antenna (58) were prepared in the aforementioned ferroelectric memory apparatus, and which discriminates a power-door-lock function and an operator, and position recognition equipment.
[0208] Therefore, according to the aforementioned (52) term, a lot of data communication and extensive memory by the electric wave (RF) are the the best for the individual ID data card of a security system. By mass data and CPU, conventionally, since possession of difficult ID, security, and exclusive data uses this method, it becomes possible.
[0209] Therefore, since possession of ID, security, and exclusive data uses this method, it becomes possible.
[0210] (53) A ferroelectric memory apparatus given in the aforementioned (44) term characterized by being the memory card which can be exchanged through radio about data peculiar to an individual to the automatic tailor equipment (automatic deposit and drawer equipment) which prepared RF antenna containing a signal strange demodulator circuit, and the microwave antenna in the aforementioned ferroelectric memory apparatus.
[0211] Therefore, according to the aforementioned (53) term, a lot of data communication and extensive memory by the electric wave (RF) are the the best for the individual ID data card of an individual information system. By mass

data and CPU, conventionally, since possession of account of difficult ID, security, and an individual, health, business, a telephone, and the data only for fax(es) uses this method, it becomes possible.
[0212] Therefore, the individual possession of all information using this method is attained.
[0213] (54) A ferroelectric memory apparatus given in the aforementioned (44) term characterized by being the memory card which can be exchanged through radio about data peculiar to an individual to the system containing home television which prepared RF antenna containing a signal strange demodulator circuit, and the microwave antenna in the aforementioned ferroelectric memory apparatus, game equipment, and a home data terminal machine.
[0214] Therefore, according to the aforementioned (54) term, a lot of data communication and extensive memory by the electric wave (RF) are the the best for the individual ID data card of an individual information system. By mass data and CPU, conventionally, since possession of account of difficult ID, security, and an individual, health, business, a telephone, and the data only for fax(es) uses this method, it becomes possible.
[0215] Therefore, the individual possession of all information using this method is attained.
[0216] (55) It has the memory cell of the ferroelectric thin film capacity pinched by the electrode of a couple. The 1st pulse which has the larger voltage Ve than the anti-voltage Vc of the aforementioned ferroelectric thin film is impressed and polarized in the 1st polarization state of the two states of spontaneous polarization (polarization). Next, the domain which impresses the 2nd pulse which has the voltage Vw with an absolute value with the aforementioned applied voltage Ve smaller than Ve of reversed polarity, and has polarization of the 1st direction of the above, In the ferroelectric random-access memory which remembers information to be the 1st direction of the above in the state of partial polarization which the domain which has the 2nd polarization of an opposite direction mixed The memory section carried in one chip or two or more chips, a control section, a high-speed optical modulator and high-speed circuit POTODAIODO, and the memory apparatus that consists of optical power generation cells and in which desorption is possible, for example, the ferroelectric memory apparatus characterized by being memory card.
[0217] Therefore, according to the aforementioned (55) term, by this method, when an electrode terminal is used, there are problems, such as a size, water resistance, and a resistance to environment, and although mass memory card is possible, since [this] the reliability of a terminal is not good, either, it is with a high-speed optical interface.
[0218] Therefore, there are problems, such as a size, water resistance, and a resistance to environment, the memory card which clears all the reliability of a terminal becomes possible, and a cell also becomes unnecessary.
[0219] (56) It has the memory cell of the ferroelectric thin film pinched by the electrode of a couple. The 1st pulse which has the larger voltage Ve than the anti-voltage Vc of the aforementioned ferroelectric thin film is impressed and polarized in the 1st polarization state of the two states of spontaneous polarization (polarization). Next, the domain which impresses the 2nd pulse which has the voltage Vw with an absolute value with the aforementioned applied voltage Ve smaller than Ve of reversed polarity, and has polarization of the 1st direction of the above, In the ferroelectric random-access memory which remembers information to be the 1st direction of the above in the state of partial polarization which the domain which has the 2nd polarization of an opposite direction mixed The aforementioned memory cell is arranged in the shape of a simple matrix on the intersection of the up electrode line which intersects perpendicularly mutually, and a lower electrode line. The ferroelectric memory apparatus by which it is characterized [by which it is formed in the upper part of the field where these memory cells contain a silicon oxide, and a circumference circuit is formed outside the field where a memory cell is arranged].
(57) The aforementioned circumference circuit is a ferroelectric memory apparatus indicated by the aforementioned (56) term characterized by being formed around the field where the aforementioned memory cell is arranged in the aforementioned ferroelectric memory apparatus.
[0220] (58) It is the ferroelectric memory apparatus indicated by any 1 term of the aforementioned (56) term characterized by the 3rd electrode which newly prepared the aforementioned up electrode and the lower electrode in the aforementioned ferroelectric memory apparatus connecting with the device of a circumference circuit, and (57) terms.
[0221] Therefore, according to the aforementioned (55) term or the (58) terms, by this method, the composition and the process after actual creation of this memory are shown, and easy composition, a loose processing rule, and few mask number of sheets can realize memory.
[0222] (59) It has the memory cell of the ferroelectric thin film pinched by the electrode of a couple. The 1st pulse which has the larger voltage Ve than the anti-voltage Vc of the aforementioned ferroelectric thin film is impressed and polarized in the 1st polarization state of the two states of spontaneous polarization (polarization). Next, the domain which impresses the 2nd pulse which has the voltage Vw with an absolute value with the aforementioned applied voltage Ve smaller than Ve of reversed polarity, and has polarization of the 1st direction of the above, In the ferroelectric random-access memory which remembers information to be the 1st direction of the above in the state of partial polarization which the domain which has the 2nd polarization of an opposite direction mixed On the field where

an active device is arranged and wiring between the active device is performed on the semiconductor substrate The ferroelectric memory apparatus characterized by for the aforementioned memory cell carrying out a laminating to the shape of a simple matrix, and arranging it on the intersection of the up electrode line which intersects perpendicularly mutually, and a lower electrode line.

[0223] (60) It is a ferroelectric memory apparatus given in the aforementioned (59) term characterized by forming the aforementioned circumference circuit and a control circuit as an active device on the aforementioned semiconductor substrate in the aforementioned ferroelectric memory apparatus.

[0224] (61) A ferroelectric memory apparatus given in the aforementioned (59) term to which the central processing unit containing the aforementioned circumference circuit or a control circuit and digital-signal-processing equipment are characterized by being formed as an active device on a semiconductor substrate in the aforementioned ferroelectric memory apparatus.

[0225] Therefore, according to the aforementioned (59) term or the (61) terms, by this method, the composition and the process after actual creation of this memory are shown, and easy composition, a loose processing rule, and few mask number of sheets can realize high-density memory.

[0226] (62) the above -- a ferroelectric -- a memory apparatus -- setting -- at least -- two -- a ** -- plurality -- the upper part -- an electrode -- the lower part -- an electrode -- a pair -- a laminating -- carrying out -- having -- **** -- things -- the feature -- ** -- carrying out -- the above -- (-- 59 --) -- a term -- or -- (-- 61 --) -- a term -- a publication -- a ferroelectric -- a memory apparatus .

[0227] Therefore, according to the aforementioned (62) term, by this method, the composition and the process after actual creation of this memory are shown, and easy composition, a loose processing rule, and few mask number of sheets can realize very high-density memory.

[0228]

[Effect of the Invention] The non-destroying ferroelectric random-access memory which can have the incoherency at the time of informational writing and the incoherency at the time of read-out, can realize destructive read by the sense circuit which combined comparison read-out by the capacity addition feedback circuit and reference cell which can read small deltaC/C without voltage change of the data line according to this invention as explained in full detail above, and carries out suitable to large-scale-ization, and its drive method can be offered.

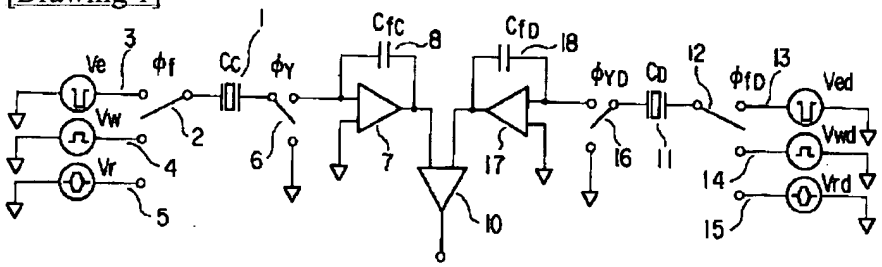
[Translation done.]

* NOTICES *

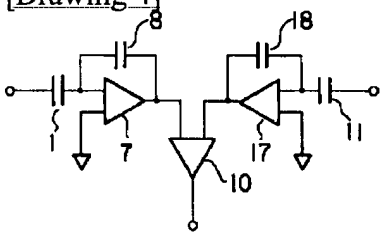
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

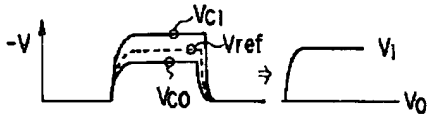
DRAWINGS

[Drawing 1]

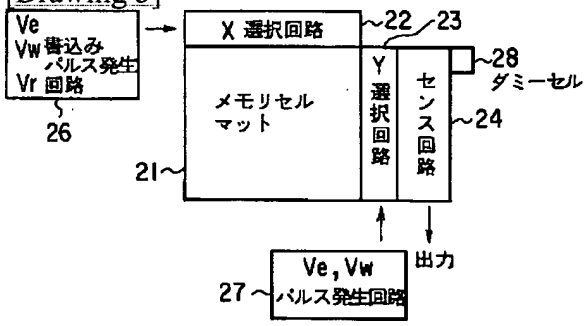


[Drawing 4]





[Drawing 5]



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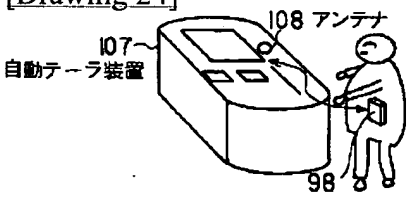
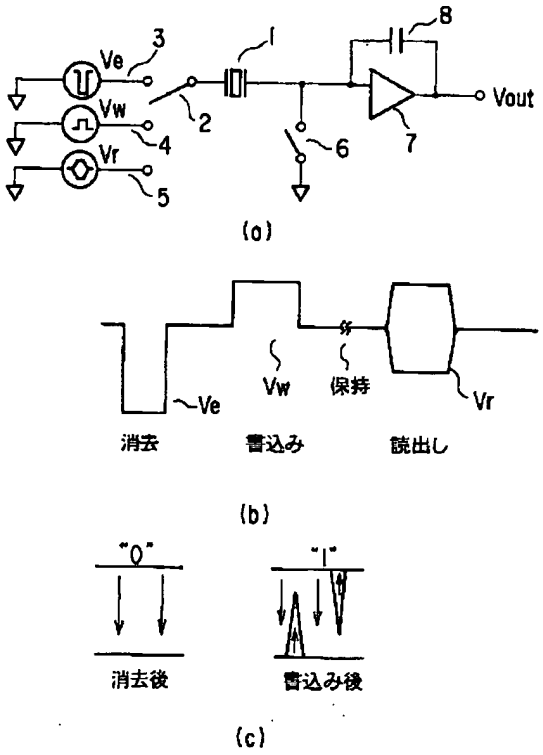
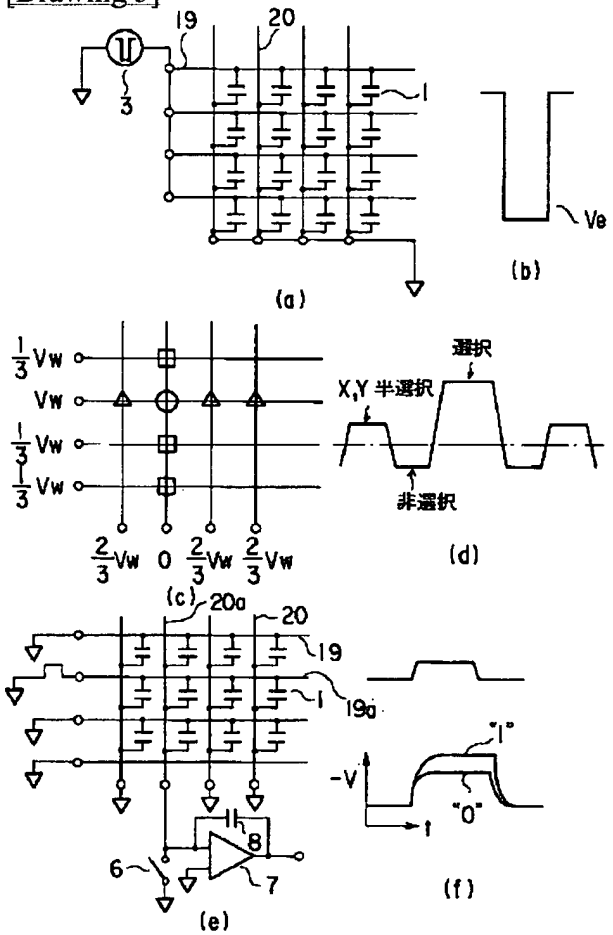


[Drawing 2]



[Drawing 3]



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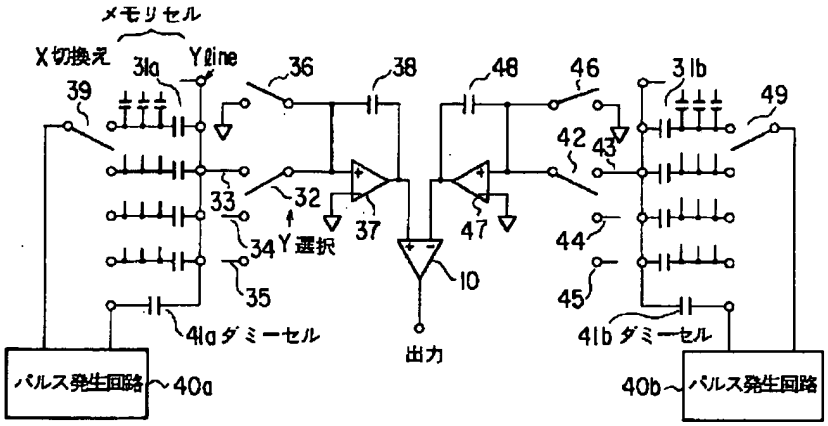
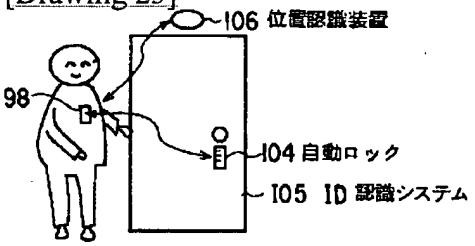
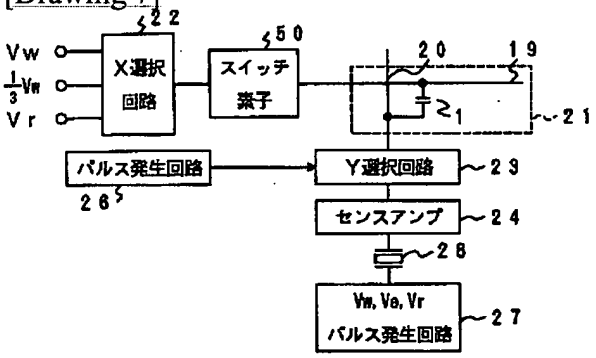


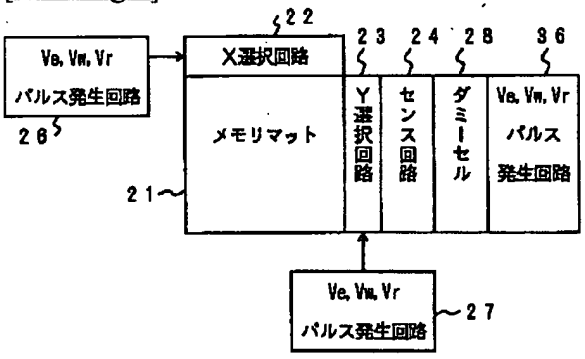
[Drawing 23]



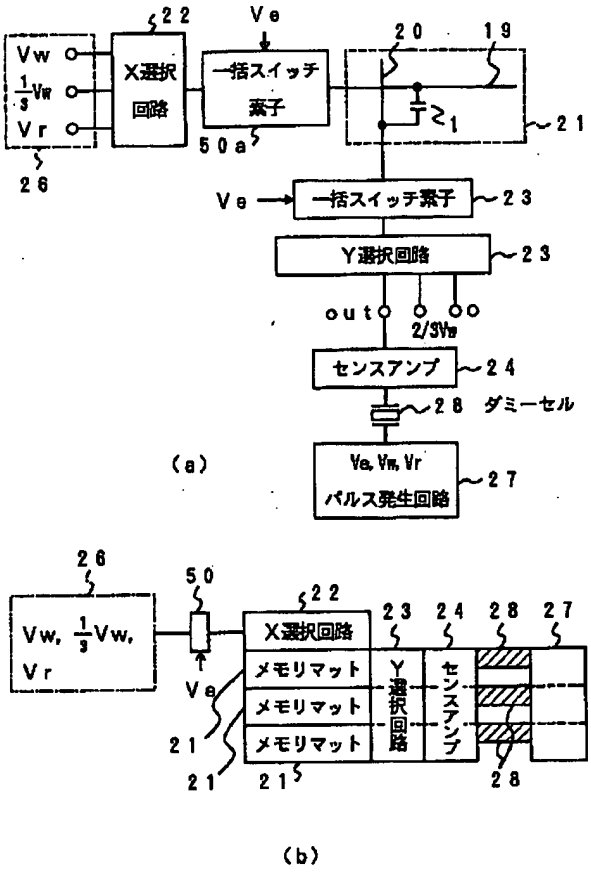
[Drawing 7]



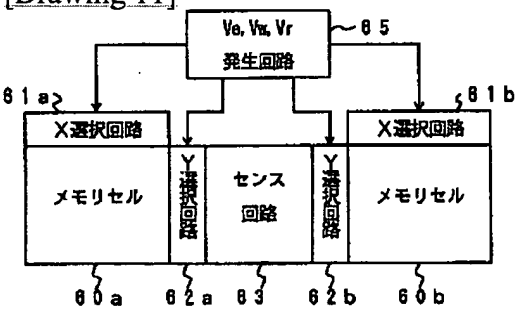
[Drawing 8]



[Drawing 9]



[Drawing 11]



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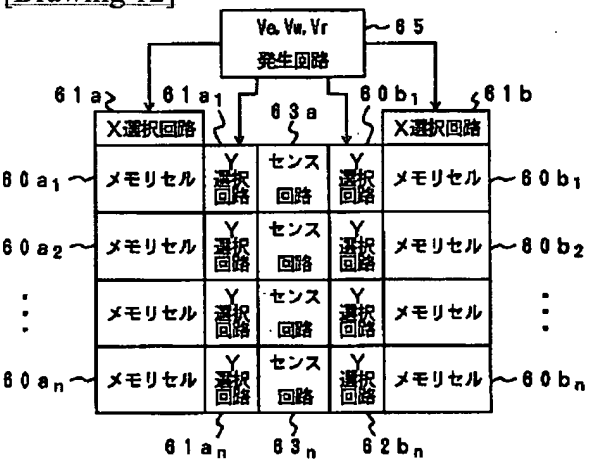
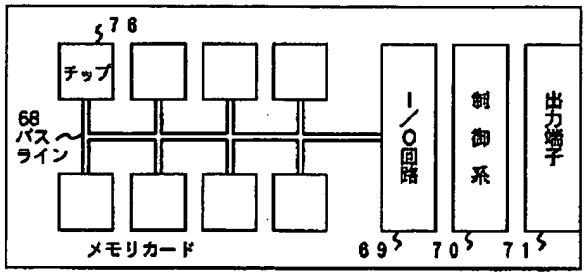


[Drawing 16]



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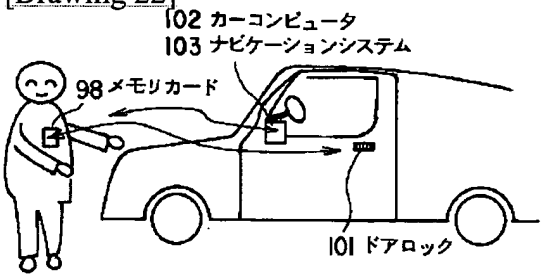
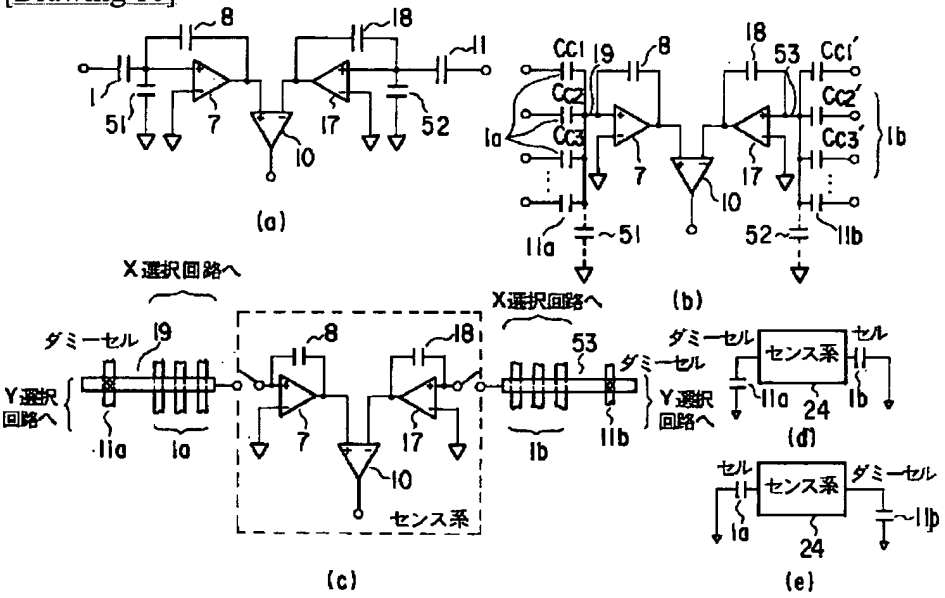


[Drawing 10]



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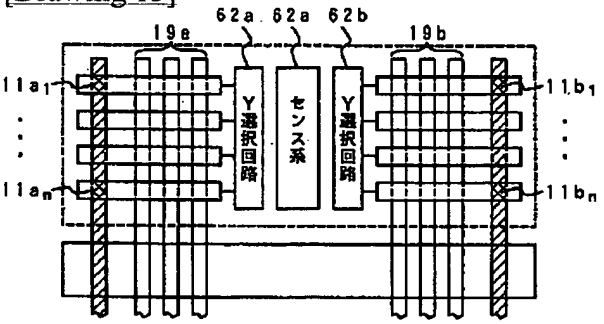
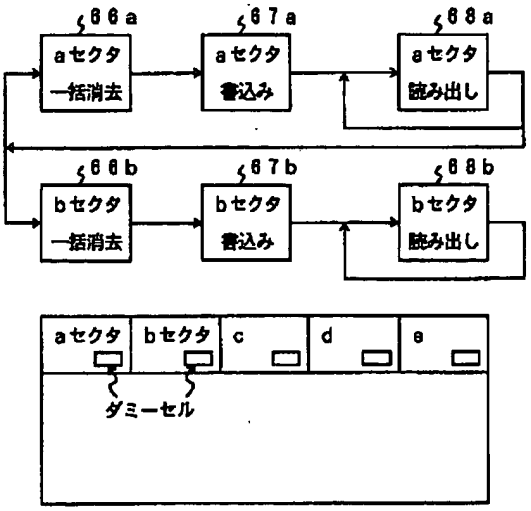


[Drawing 14]



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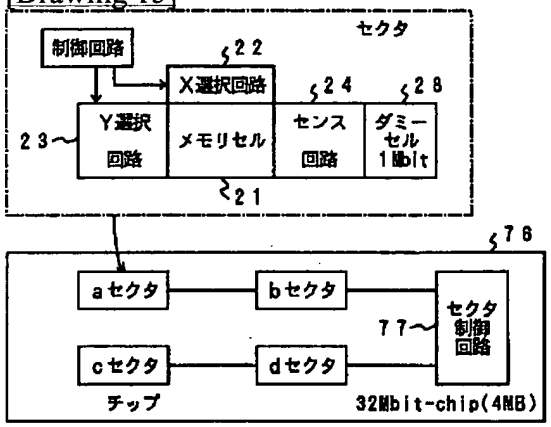
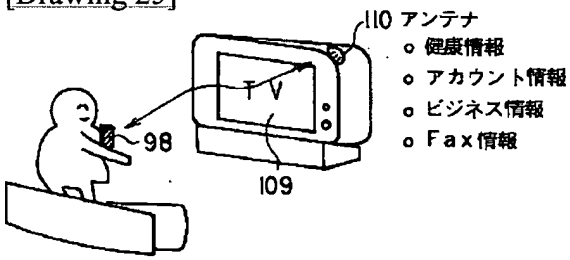
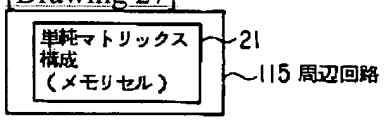


[Drawing 25]



[Drawing 27]



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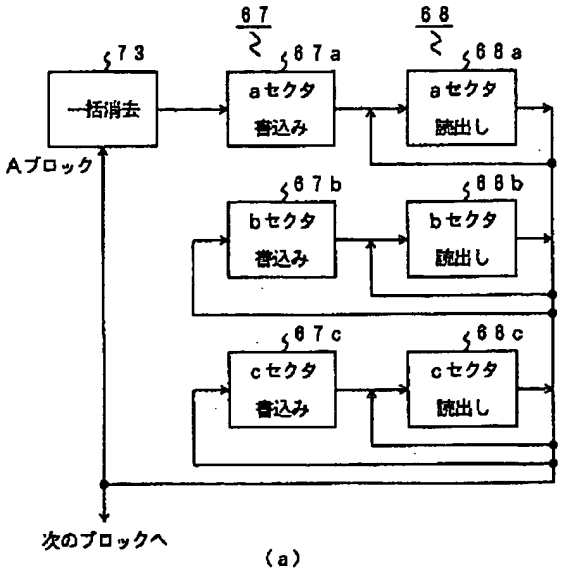
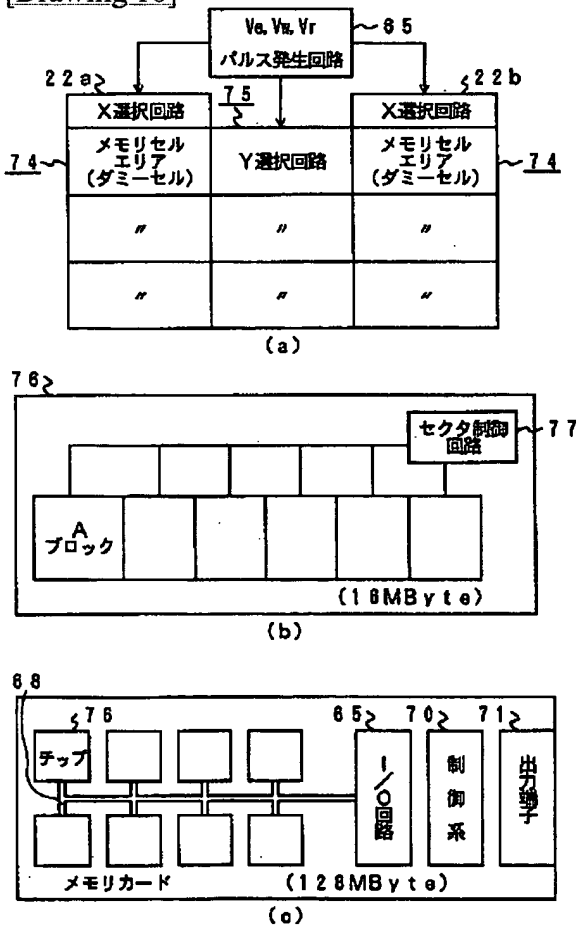
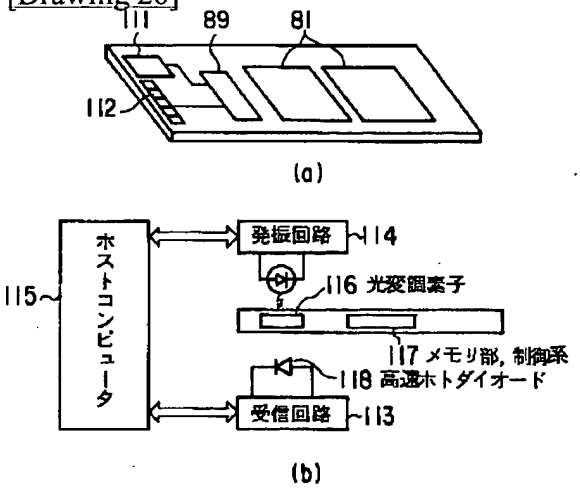

67
68
73
67a
68a
一括消去
aセクタ
書込み
aセクタ
読出し
Aブロック
67b
68b
bセクタ
書込み
bセクタ
読出し
67c
68c
cセクタ
書込み
cセクタ
読出し
次のブロックへ
(a)
aセクタ
bセクタ
cセクタ
dセクタ
66
28 ダミーセル
ブロック72
(b)

[Drawing 18]


Va, Vw, Vr
パルス発生回路
65
22a
22b
75
X選択回路
X選択回路
メモリセル
エリア
(ダミーセル)
Y選択回路
メモリセル
エリア
(ダミーセル)
74
74
〃
〃
〃
〃
〃
〃
(a)
76
セクタ制御
回路
77
A
ブロック
(16MByte)
(b)
68
76
チップ
65
70
71
I/O回路
制御系
出力端子
メモリカード
(128MByte)
(c)

[Drawing 26]



[Drawing 28]

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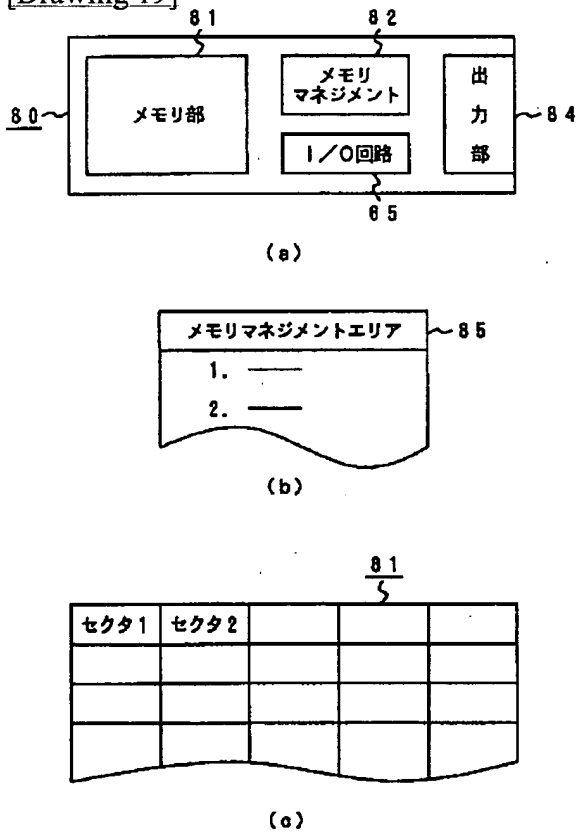
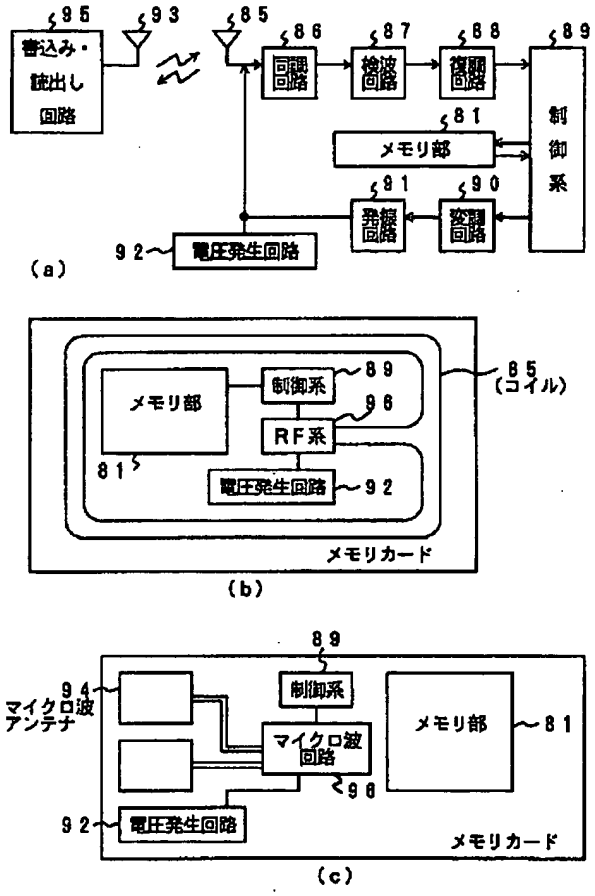


[Drawing 20]



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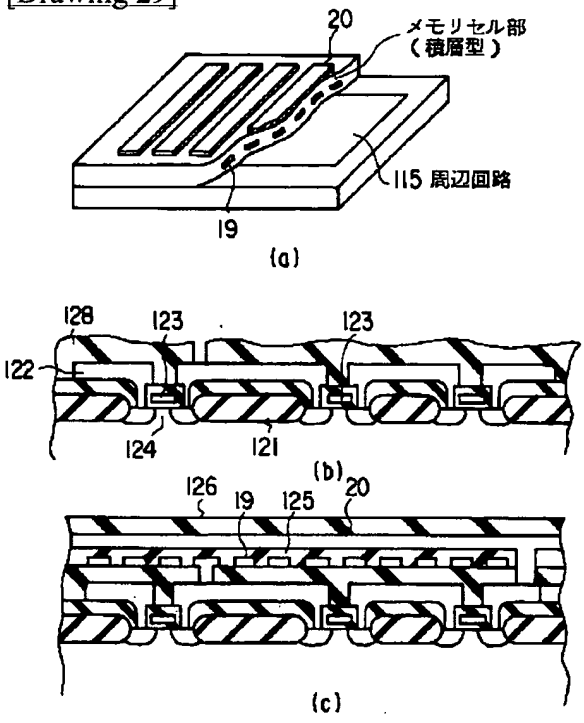
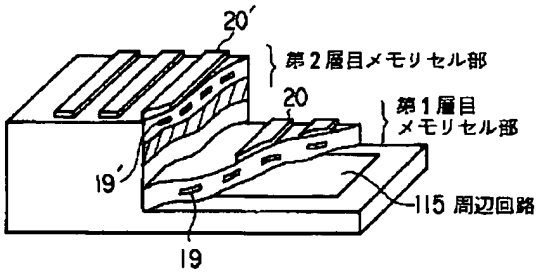
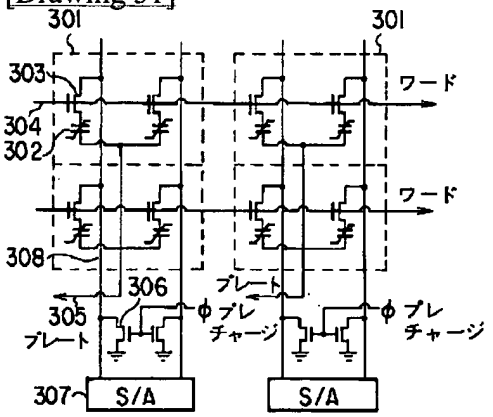


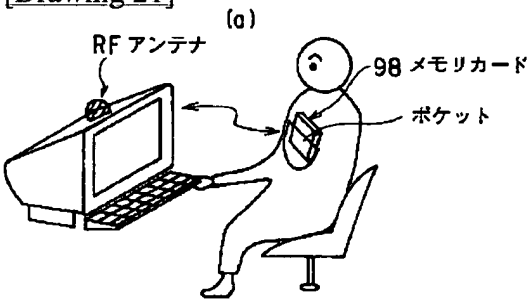
[Drawing 30]

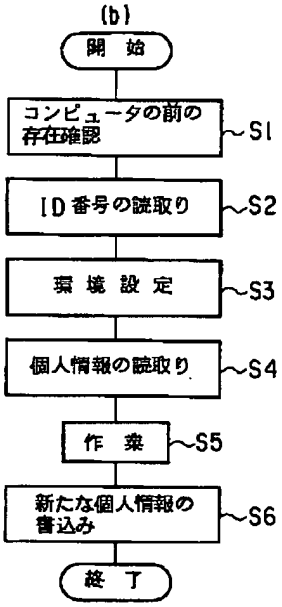


[Drawing 31]

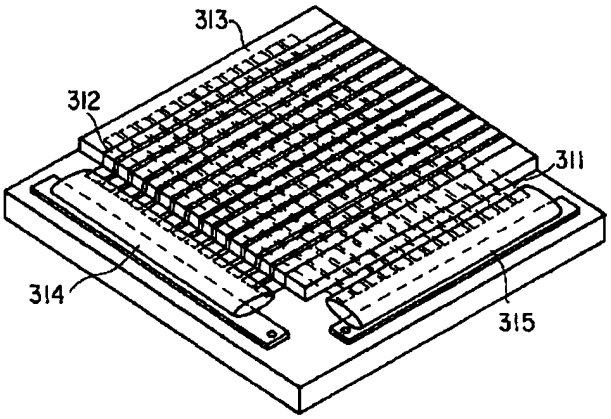


[Drawing 21]

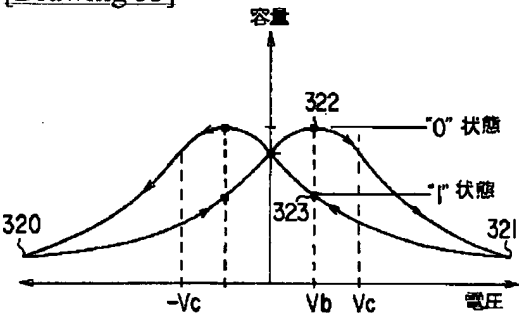




[Drawing 32]



[Drawing 33]



[Translation done.]